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A MANUAL OF
SCHOOL HYGIENE

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A MANUAL

OF

SCHOOL HYGIENE

WRITTEN FOR THE GUIDANCE OF
TEACHERS IN DAY-SCHOOLS

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PREFACE.

IN the following pages an attempt has been made to set forth in plain language the guiding principles of the hygiene of childhood so far as it is affected by the circumstances of school-life. The time has passed when the teacher could leave the question of health to the beneficent care of Nature. In great towns Nature has been expelled with a pitchfork, and in the course of a generation compulsion and the examination system have insensibly but steadily increased and tightened the pressure brought to bear on children from the age of five years and upwards. Teachers and pupils alike work under a new and unhealthy pressure, and great watchfulness and care are required to avoid evil consequences.

Fortunately no great amount of detailed knowledge is necessary, but rather observation directed to a right purpose. Part of the object of this book is to inculcate the importance of studying children at first-hand and sifting and selecting those influences which tend to do good from those which tend to do harm. In day-schools three sets of circumstances require consideration. I. The home-life and its surroundings, often exceedingly unhygienic and often entirely beyond the control of the teacher except as a friendly adviser. This is beyond the scope of the present writers. II. The conditions which affect children from the outside, as the arrangements of school-buildings, regulation of temperature, epidemics and

accidents, etc. These are dealt with in Part I. by Edward W. Hope. III. The management of the child as a growing and living creature. This forms the subject of Part II. written by Edgar A. Browne.

Though many reforms are confessedly needed, nothing has been urged that is not within the power of teachers under existing regulations to accomplish. Much has been done of late years for education and the welfare of children, but much remains to be done. Nothing so effectually bars progress as a contented optimism; nothing so effectually tends to improve an institution as a lively discontent springing from a knowledge that a better state of affairs is possible. The first step is increased knowledge on the part of those engaged in the routine work of teaching. They can—if they will take the pains—supply the facts in the life-history of young children that no other observers can glean with an equal facility and continuity. And though the principles of health must necessarily come from the outside as the results of the labours of the physiologist and the medical man, details in the practical work of the school must be in the hands of the teacher. It depends ultimately on his knowledge and convictions whether an individual child is or is not brought up in that fulness of health which it should be the first duty of an educational system to promote.

We desire to acknowledge our obligations to Messrs Willink and Thicknesse, of Liverpool; to Messrs Ashwell and Nesbit, of Leicester; and the proprietors of the *School-Board Gazette* for the use of plans and sections of school-buildings.

E. W. H.
E. A. B.

May, 1901.

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PART I.

CHAPTER I.

SITE AND SOIL.

It is evident that in the main, the selection of the *school site* must be limited by general considerations of cost, convenience, contiguity to the population to be served, and so on; the necessity for a perfectly wholesome site must however be carefully kept in view and weighed against temporary advantages which may arise on these grounds. Teachers and taught alike are peculiarly susceptible to conditions which are likely under any circumstances to be prejudicial to health; the confined and sedentary nature of the occupation and the mental activity required affect both teachers and pupils, whilst proneness to attacks of some forms of sickness may be regarded almost as incidental to the earlier years of life.

Unwholesome conditions of soil, often avoidable ones, are known upon very definite evidence to be associated with certain forms of disease, and the need for careful selection of site is fully established. If the less desirable ones cannot be altogether avoided, their objectionable features can often be removed if sufficient care be exercised in dealing with them.

The composition of subsoil even in neighbouring or contiguous localities may vary within wide ranges; more especially in the suburbs or outlying districts of growing cities, where

may arise the dangers associated with "made" land, and it is clearly impossible always to select exactly such soil as knowledge and experience prove to be the best. For the reasons already indicated, it does not appear necessary to go at any length into the specific connections between soils and climate, but it may be pointed out that the physical conformation of the locality, elevation, fall of plains, watershed &c. exercise influence upon the healthiness of the district. Places where circulation of air, and access of sunlight are interfered with, whether because they be natural ravines and hollows, or whether they be spots surrounded and shut in by trees or by lofty buildings on higher ground, are unhealthy, and unsuitable for school buildings. Moreover such depressions, or those below the level of plains may be damp, and consequently unwholesome from surrounding subsoil drainage.

Soils exercise their important influence upon buildings, chiefly by the readiness with which moisture (dampness) or impurities may be brought into them. It must be remembered also that it is not merely that portion of the site actually covered by occupied rooms, which is important, but under certain circumstances the occupants may be affected by conditions of subsoil which exist at considerable distances. All soils, except perhaps the hardest rocks, are more or less porous, containing innumerable interstices comparable to those of a hard, close sponge; these are filled either with "ground" air, which differs widely in its composition from ordinary atmospheric air, or with "ground" water, which also may be widely different from pure water, and may in fact bring dangerous impurities from a distance. The interstices of the soil then are occupied alternately and for varying periods either with ground air, or ground water; as the water recedes in dry weather it will leave behind it some at least of any impurities which may have been dissolved or suspended in it, and these, by their decomposition, modify the nature of the air in the soil, *i.e.* the "ground" air.

The air in soils differs from atmospheric air in important particulars. The amount of carbonic acid gas is in excess, the amount increasing with the depth of the strata from which the soil air is taken; at the same time the amount of oxygen is diminished. Soil air, again, is usually very moist; it may also contain organic constituents from the decay of animal and vegetable substances. Rainfall and warmth exercise an important effect upon the composition of soil air, as well as upon its movement; variations in volume by change of temperature give rise to continual movement, and the rise of the ground water, consequent upon rain, will slowly force out the soil air. It is not difficult to understand that occupied buildings, artificially warmed in winter, and almost always warmer than the ground which surrounds the sites upon which they stand, must, unless means be taken to prevent it, be continually drawing in ground air not only from below, but also laterally. When the surrounding surface is impervious or rendered so by paving or frost, this is especially likely to happen. In this way leakages, *e.g.* of coal gas, may pass from long distances into schools or occupied buildings and noxious oozings and emanations from defective cesspools, and middens, or from accumulations of manure &c., may also be causes of mischief to premises at a distance. It is especially obvious that schools built on "made" land may be rendered unhealthy so long as the constituents of the foundation contain decomposing impurities, since the impure ground air may ascend into the rooms.

Water, instead of air, may occupy the interstices of soil, and may be derivable from rain, or from percolation and capillarity from subterranean water, pressure from rising of adjacent rivers, &c.

The capability of soils for absorbing and retaining water varies very considerably; almost all soils will take up some, loose sand may absorb as much as two gallons in a cubic foot, sandstone about one gallon, chalk takes up about 15 %, clay

20 %, and is very retentive of it. The distinction must be borne in mind between a soil which is merely permeable, one which takes up water readily, allowing it to percolate through and which dries quickly, and an absorptive soil, retentive of moisture, permeable only to a very limited extent, and remaining wet. Sandstones illustrate the first case, clay the second, rock, which is almost impervious, absorbs practically none.

The rise and fall of ground water is shown by the rise and fall of water in wells, but careful observation is necessary in order to ensure correctness in conclusions.

It will be evident that when soils are damp from any cause a non-retentive permeable soil can be more easily made dry by subsoil drainage than one which does not admit of ready percolation; special drains to take off ground water are frequently laid by the side of sewers.

It is, however, the nature of the soil of the immediate locality that is of importance in the influence which it is likely to have upon the health of the occupiers of the schools. The dry and impermeable rocks, slates, chalk, gravel, permeable sandstones, are usually healthy and dry, unless in the latter case clay may underlie a superficial sand-rock, or sandy soil, when dampness may be found. Clays and alluvial soils are frequently wet and damp and require to be carefully dealt with.

Much attention must be given to the nature of *made soils*, since special importance attaches to the subject by reason of the frequency with which such sites are met with in the rapidly growing suburbs of great towns; these may or may not be unhealthy, and the difference depends upon the original character of the deposited refuse, and the length of time which has elapsed since the deposits were made. Many years ago a careful examination was made into made soils in Liverpool, at the instance of the Corporation, by Drs Parkes and Burdon Sanderson; it was found that in the case of inequalities of the ground which had been filled up with ash-pit refuse, vegetable matter had disappeared in about three years, as also cloth,

wood, and other fibres; other textile fabrics, also hair &c., are much more permanent. Made soils should be carefully examined, and in every case carefully drained.

Without entering into the general question of the well-known influence exerted upon health, and the incidence of diseases by soils, it will be sufficient to say that the influence of damp soils in producing and accentuating diseases of the lungs is established. The same condition, dampness, and the cold associated with dampness, predispose to various forms of rheumatism. Filth-laden soils or the effluvia from them may contribute to, or be responsible for outbreaks of diarrhœa, dysentery, or enteric fever, and may confidently be expected to cause deterioration in health and to give rise to frequent malaise, of a kind likely to interfere seriously with the powers of mental application.

CHAPTER II.

THE SCHOOL BUILDING.

In order to exclude the possibility of damp as well as to keep out ground air, it is necessary to completely cover the whole of the site with concrete, or some material equally close and hard. The character of the material used is of the utmost importance; only the best concrete which can be obtained should be employed, the inferior kinds met with contain too little lime or cement and crumble away, leaving interstices into which air will pass or water will creep by capillarity, not only making the house unwholesome, but possibly endangering the structure. The necessity for careful attention to these precautions is obvious. In the absence of some special foundation, danger may arise not only from gases immediately beneath the building finding their way into it, but—especially in times of frost—they may be drawn from considerable distances beneath the hard frozen surface of the ground. The thickness of the cement concrete should be from 4 to 6 inches.

In many instances this concrete may serve as a floor itself; in passages, halls, out-buildings, this would be the case. When a boarded floor is necessary a space should be left for ventilation between the concrete and that floor. This measure serves as a valuable precaution against dry rot, and a clear and continuous space of at least three inches between the underside of every joist of such floor and the general surface

of the asphalte or concrete with which the ground beneath may have been covered, should be allowed. The ventilation of this space can be ensured by means of air-bricks. (Figs. 1 and 3.)

Special care must also be taken to protect the part of the walls which is situated below the level of the ground, and with a view to render them impervious to damp, exceptionally good

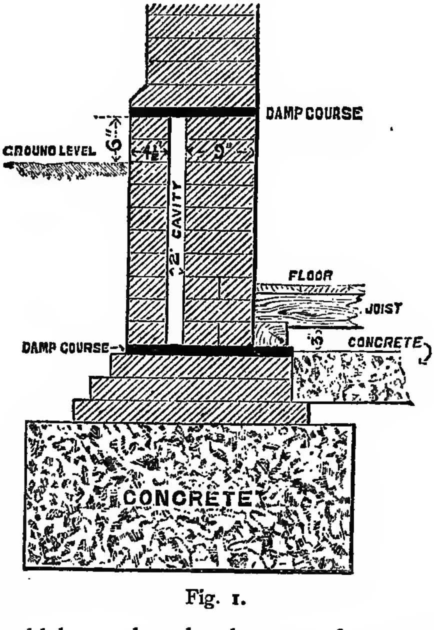


Fig. 1.

material should be used, and a damp-proof course provided in the wall all round the building, or this part of the external wall may be constructed with a cavity 2 or 3 inches wide between the external and internal faces of the wall, the two portions being joined by bonding ties of suitable material of a non-absorbent character. (Fig. 1.)

In order to prevent the passage of moisture up the walls of the building, a damp-proof course must be laid completely across the wall, and extending all around the building. This

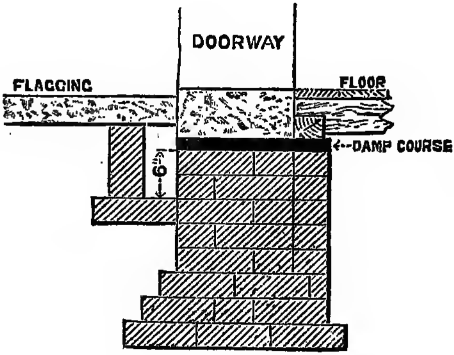


Fig. 2.

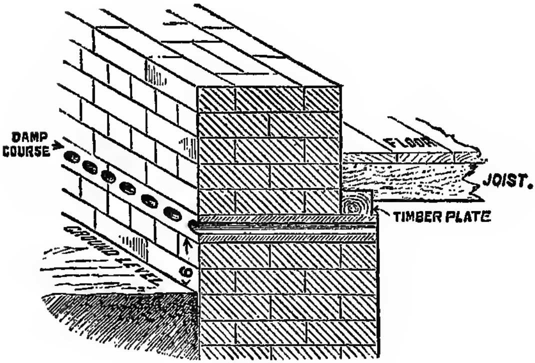


Fig. 3.

damp-proof course should be laid a little distance, say a few inches, above the ground level, and it should be employed in

all cases, whether the site be a damp one or not. It may consist of asphalte, slate, cement, or pitch, or slate in cement, or other material. Sometimes a sunk area may be necessary, in order that any mound of earth rising higher than the damp-proof course may be kept away from the wall. In this way the building would either have an open area above the damp-proof course or a specially constructed dry area.

Questions of solidity, foundations, proper width of footings, solidity and thickness of walls, &c. fall within the province of the architect and the builder.

Whenever the dampness of the site renders such a precaution necessary, the subsoil should be drained by means of suitable earthenware field pipes, properly laid to a suitable outfall.

Whilst such careful precaution is necessary to protect the building from damp from below, it is equally necessary to guard against dampness from rain falling upon the roof; suitable gutters and downspouts must therefore be provided to carry off such water, and these downspouts must not pass down direct into the drain, but terminate over suitable trapped gullies.

SEWERAGE.

Some of the salient points in connection with the drainage must be considered in a little more detail. The "house drain" or "private communicating sewer" between the soil pipe and the main sewer should be constructed of stoneware glazed pipes, jointed in such a manner as to be absolutely watertight. It should in no case pass under any part of the building, unless this cannot be avoided. It should then, in that part of its course, be bedded in concrete at least six inches thick all round, and provided with means of inspection at either end.

The whole course of this "private connecting sewer" or "house drain" should be in a straight line, or as direct as possible: if one line cannot be adopted, there should be straight lines from angle to angle with an inspection shaft at each angle. It should be laid at such an inclination as will secure a velocity of not less than 3 feet per second, and the diameter should be 4 or 6 inches in accordance with the number of lavatories discharging into it. A disconnecting trap with a fresh air inlet on the house-side of it, should be placed upon the house drain at a convenient place near to the common sewer.

The soil pipe should be 4 inches in diameter and left open at the top, which should be carried to a safe place above the eaves without any lessening in the diameter. Sometimes a wire cage is placed over the soil pipe to prevent birds building in it.

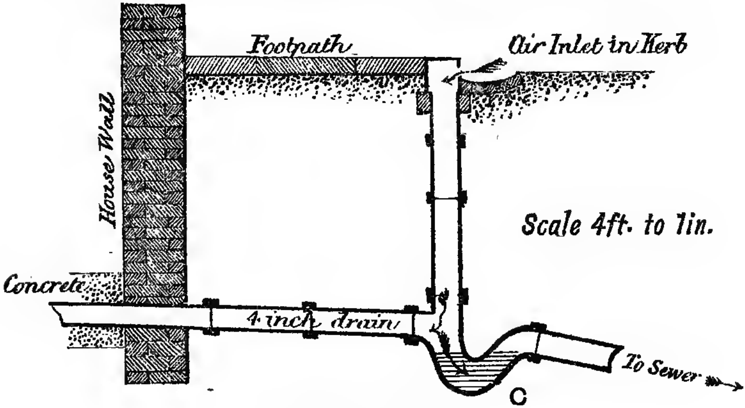
Provision should be made for flushing the house drain in addition to the incidental flushes given when the waterclosets or lavatories are made use of.

Drains, Lavatories, Waterclosets.

The general aim in connection with the drainage of a building is to ensure a prompt and complete removal of all waste, deleterious matter, the retention of which may prove prejudicial to health.

This is effected by means of suitably arranged pipes or drains which shall convey the waste water from baths, lavatories, &c., but the removal of this and the construction of the pipes must be so arranged that, whilst they permit water to flow away into the sewers, they shall not permit the access back again of any gases, produced by decomposition, from the drains or sewers themselves into the building.

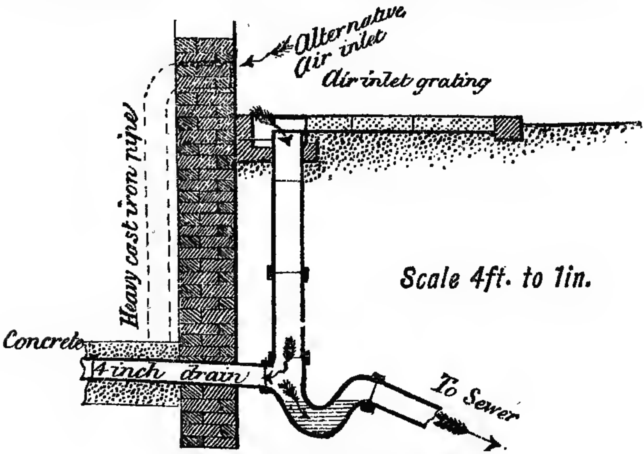
MAIN DRAIN DISCONNECTING TRAP WITH AIR INLET IN KERB OF STREET FOOTPATH.



GENERAL SECTION.

Fig. 4.

DETAIL OF MAIN DRAIN DISCONNECTING TRAP WITH AIR INLET IN STREET FOOTPATH.



GENERAL SECTION.

Fig. 4 *a*.

DRAINAGE FROM SINK, BATH AND RAIN WATER PIPE.

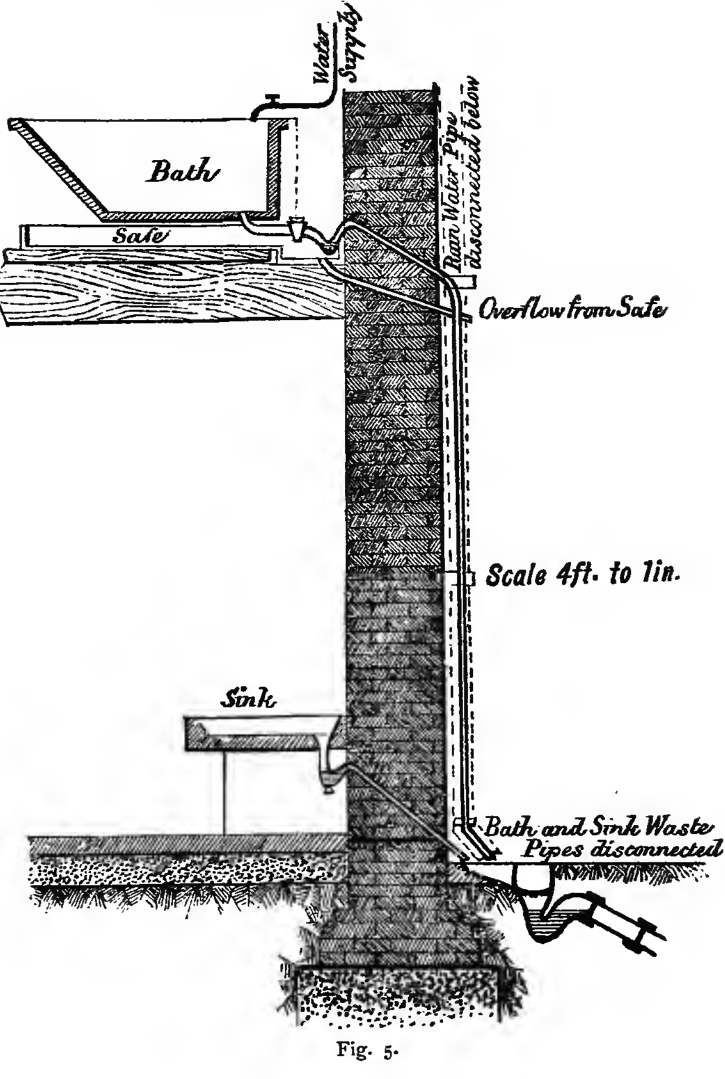


Fig. 5.

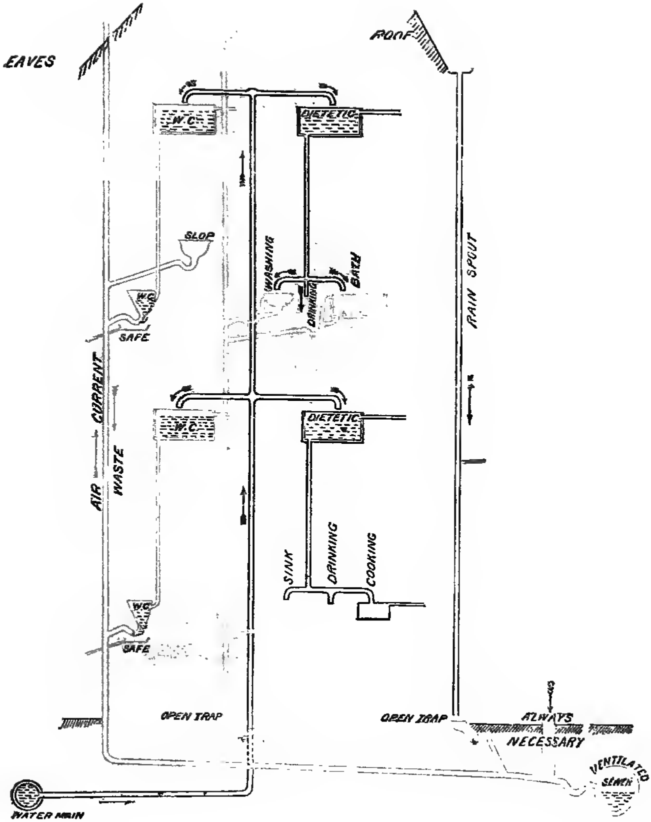


Fig. 6.

To face p. 13

The object is attained by the use of simple ventilating traps, so placed as to afford no obstruction to the outflow of the liquid, whilst they effectually prevent the reflux of gases into the building, the pressure in the sewers being relieved by appropriate ventilation into the open air. A trap is the name given to a bend placed upon the pipe in such a manner as to permit the flow of liquids but prevent the reflux of gases. (*C*, Fig. 4.)

The diagram (Fig. 6) indicates the principles to be aimed at. The system coloured *red* indicates that section of the drainage system connected with the watercloset and with the disposal of *foul water.* It will be seen that the outflows from the closets and the slops passes directly into the soil pipe, which, placed external to the building, is continued straight up to the roof without bend or curve, and is open at the top full bore. Below, the soil pipe is directly continuous with the drain, which with an appropriate fall, to ensure sufficient velocity to its contents, passes first an open ventilator and immediately after that a trap, before terminating in the ventilated sewer. Separate cisterns are provided for flushing the closets or lavatories. *Waste water* from baths and sinks is dealt with by the system coloured *yellow*, and it will be seen that the yellow pipes do not pass directly into the drain but they terminate in the open air over a gully, which is itself trapped off from the drain. The *pure water* supply is indicated in *black.* Further, a long black line indicates the way in which the downspouts carrying off *rain water* are dealt with. These also terminate over trapped and ventilated gullies. They must not pass down into the drain direct, nor can they be made use of as ventilators for the drain, because in times of rainfall they are running full and consequently cannot act as ventilators.

Cloak-rooms.

It is essential in every day-school to provide adequate space for hats and coats, &c., and for drying overcoats, and other outer garments, boots, &c., in wet weather. Cloak-rooms should be large, provided with hooks and rails, or partitions sufficient to allow one for each scholar, and sufficiently spaced so that the clothing of different scholars may not hang in contact; a place for umbrellas should also be provided. A drying chamber can be used by an attendant for drying the wet clothing during school hours.

The approach to the cloak-room should be easy, to avoid crushing, and it should be provided with a separate exit; the ventilation must be very free, otherwise the room will become close and offensive.

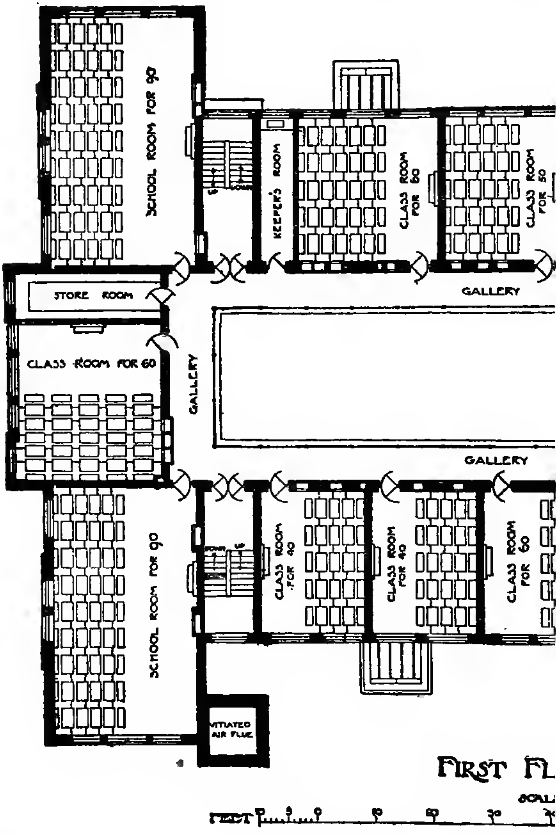
Class-rooms.

The class-room is not, as a rule, occupied more than one hour at a time without an opportunity for thoroughly ventilating it in this way for at least a few minutes; the size of the room will vary greatly, but as the number that one master or mistress can control and effectively teach will average thirty, a room to accommodate this number, allowing a minimum of 350 cubic feet per scholar, may be taken as the type. What has been said in regard to the connection between ventilation and cubic space must be borne in mind and every opportunity to ventilate the room must be taken. The height of the class-room is a matter of importance; in calculating cubic space no greater height than twelve feet should be considered as advantageous.

It should be the duty of the head master or head mistress to see that whenever the class-room is temporarily vacated the windows should be opened.

The question of *lighting* of school-rooms is fully dealt with in Part II.

THE FOLLOWING PLANS ILLUSTR
OF A LARG



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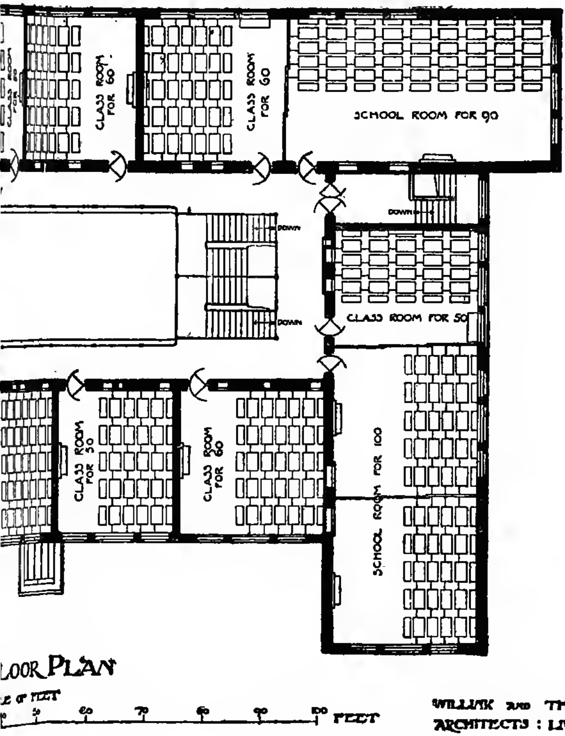
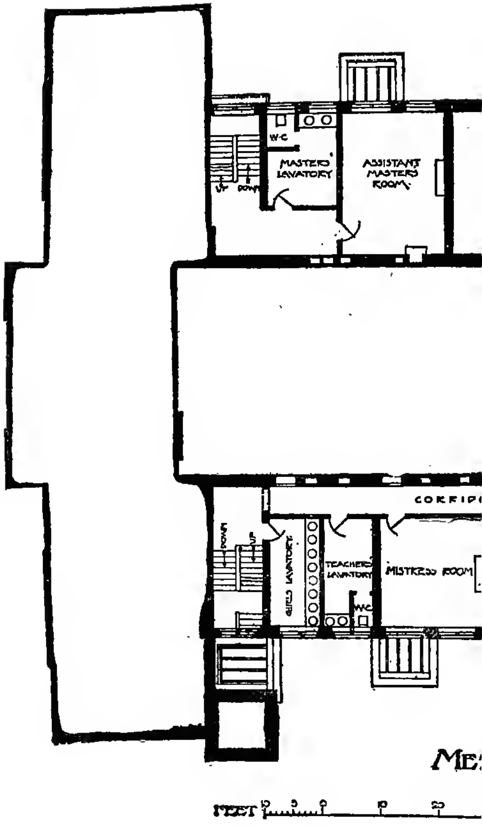
RATE THE GENERAL ARRANGEMENTS
GE BOARD SCHOOL.



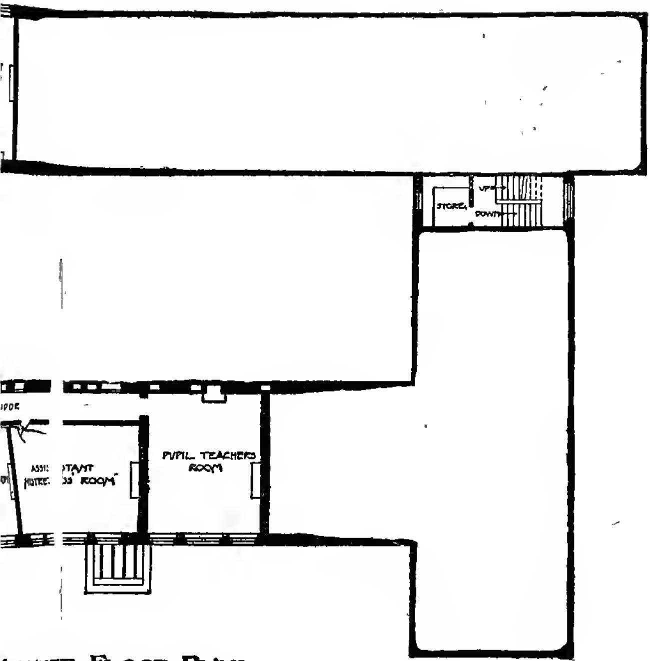
LOOR PLAN

WILLINK AND THICKNESSE
ARCHITECTS : LIVERPOOL.



To follow Plan I.

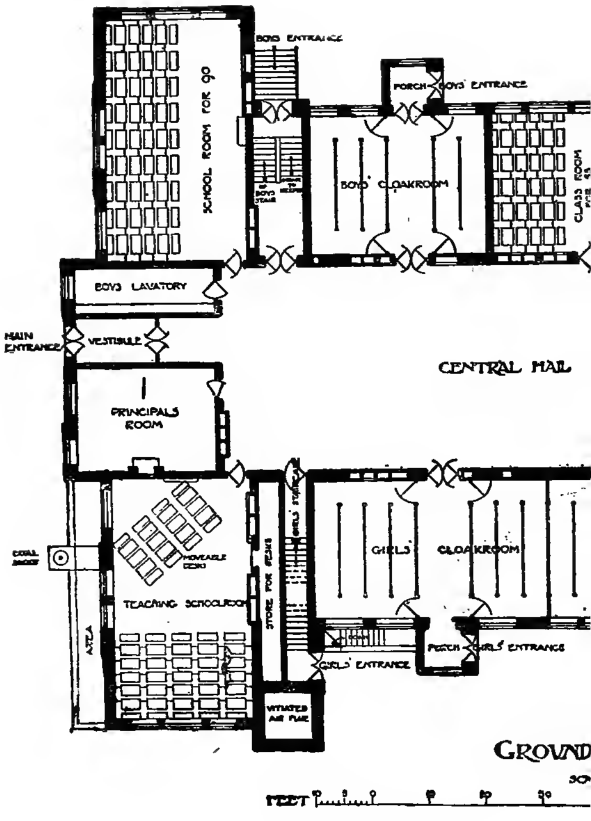
PLAN II



IEZZANINE FLOOR PLAN

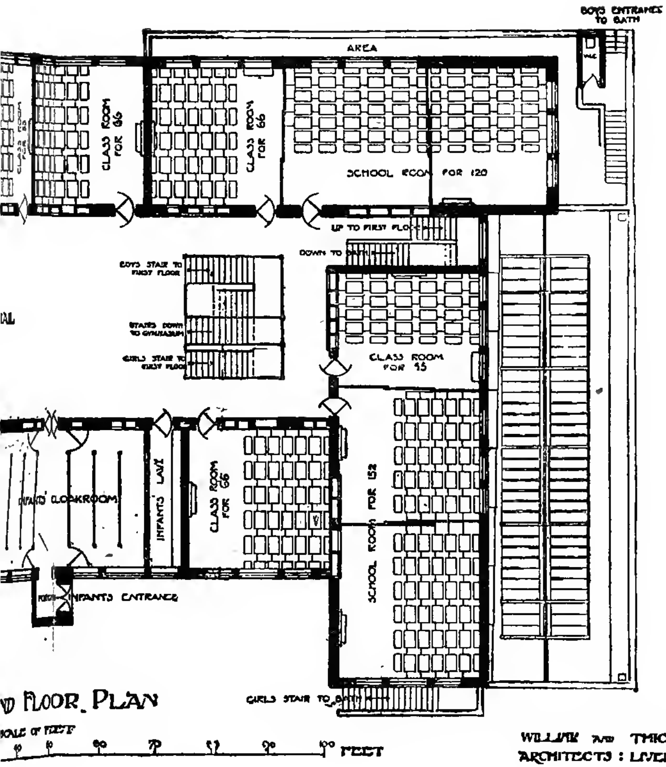
SCALE OF FEET

30 40 50 60 70 80 90 100 FEET



To follow Plan III.

PLAN IV



WILLIAMS AND THICKNESSE
ARCHITECTS : LIVERPOOL

Assembly room.

It is necessary, for certain functions, to assemble the whole school from time to time. The hall used for this purpose should be carefully warmed, lighted, and ventilated.

Playgrounds.

Every school should have its playground; sheltered and sunny as possible, fairly level, and well drained if the site is a damp one. In town schools the difficulty in procuring adequate space is a great one, and the pupils should be encouraged to use the public parks and playgrounds.

The Building Rules, from the Day School Code of the Board of Education are deserving of careful perusal. They are contained in the Appendix to this book, page 70.

CHAPTER III.

AIR, VENTILATION AND WARMING.

Purity of the air is the most important of all the conditions which influence health. Impure air is a more frequent and more fruitful cause of sickness and mortality than any of the other causes which under ordinary circumstances are in operation; there are few, if any facts in the science of sanitation more definitely established than these, and whilst some forms of disease, such as typhus fever or tuberculosis require impure air as a condition necessary to their spread, almost every form of illness is accentuated, and convalescence is always delayed as a consequence of breathing impure air.

Air is liable to many impurities and may receive contamination in a great variety of ways, but it must be borne in mind that the most frequent form of contamination is that which takes place from the processes of respiration within occupied rooms, and it is this very form which most conduces to lowered vitality and ill-health, especially amongst children, and which furnishes the most ready medium for the spread of infection.

Composition of Air.

The average composition of the air may be given as follows:

Oxygen	20·9 per cent.	
Nitrogen	79·0 ,, ,,	
Carbonic Acid (Carbon Dioxide)	0·04 ,, ,,	(or perhaps less).

Also traces of ammonia, organic matter, ozone, salts of sodium, and, as recent researches indicate, about 1 per cent. of what was regarded as nitrogen, is an elementary gas called *argon*. There is also present a certain amount of watery vapour which varies in quantity with the temperature.

Air is a mechanical mixture and of practically uniform composition from whatever natural source it be derived; the quantity of free carbonic acid is subject to slight fluctuations; in enclosed places and in the vicinity of decomposing matter, impurities may be found, but apart from these, the uniformity of the mixture is maintained by varying temperatures and consequent winds and currents, and by the natural law of gases to diffuse; thus, if a heavy gas and a light gas are placed together in a vessel, the heavy gas below and the light above, they slowly mix even when left at rest; but, when once mixed, they show no tendency to separate, and however long the mixture is kept, the mixture at the top will be found to have the same composition as that at the bottom. The rate of diffusion of gases is inversely as the square roots of their densities.

The nitrogen in the air appears to act as a diluent of the oxygen, the latter being essential to the maintenance of combustion and of life; ozone is regarded as a concentrated form of oxygen, three volumes being condensed into two. Carbonic acid gas is one of the normal components of the atmosphere; it is formed by the action of oxygen upon tissues containing carbon; substances used as fuel contain a proportion of carbon, and this in the process of burning, combines with the oxygen of the air to form carbonic acid gas; in the processes of respiration, the oxygen of the air, conveyed by the blood, combines with the carbon in the body, as it passes through the lungs the blood gives up the carbonic acid gas, and receives a fresh supply of oxygen. It will be evident that in both cases the conversion of carbon into carbonic acid is concerned with the production of heat. Under the influence of light the green colouring-matter

of plants takes up carbonic acid gas, retaining the carbon and liberating the oxygen. When carbonic acid is produced in a vessel closed at the bottom, such as a tan-pit or a brewer's vat, or poured from cracks or crevices into a well or mine it remains as a layer at the bottom, owing to its density being 1½ times that of air, only slowly mixing with the air by diffusion. Loss of life has frequently been caused by persons incautiously descending into such pits, as carbonic acid not only does not support animal life but is directly injurious.

Ammonia, except as an impurity, is present only in the minutest traces; the largest trace is present in summer, diminishing with fall of temperature and rainfall. Ammonia is a product of the decomposition of nitrogenous matter, and vegetation derives much of its nitrogen from this source.

Organic and suspended matter are present only in minute quantity in normal air; excess, such as may be found in inhabited places, is abnormal and an impurity.

Watery vapour present in the atmosphere is constantly varying in amount; the quantity passing into the air by evaporation, the quantity remaining, and the quantity condensing out in the form of rain, &c., are dependent upon temperature and pressure. Under any circumstances of temperature and pressure, a given space can only contain a given quantity of vapour, and if when the air is charged with vapour (*i.e.* contains the greatest possible amount under the circumstances) the pressure is increased, a certain quantity of that vapour will be condensed and will pass into one or other form of water; if, however, the surrounding air is not charged with vapour, evaporation will go on from any surface of water until it is so charged. Air is said to be *saturated* when the amount of vapour is at its maximum, and any increase will result in condensation; air is "dry" or "moist" in proportion as it approaches the point of saturation. Alterations in the *temperature* cause changes in the density, and consequently in the pressure; the increased density produced by fall of temperature

increases the pressure. All atmospheric movements result from variations in the temperature.

IMPURITIES OF AIR AND THEIR SOURCES.

An immense number and variety of particles, organic and inorganic, of vapours and gases, pass into the atmosphere; amongst the kinds of dust are mineral matters, algæ, pollen, dried particles of debris from road and midden refuse, manure, soot, and products gaseous and particulate from factories and industrial works of all kinds. Microbes are found, sometimes in excessive numbers, and the purport of their presence is still the subject of careful investigation; moisture, nutritive material, and a certain degree of warmth are essential to their development; their numbers vary enormously in different localities and they also vary, though to a much less extent, at different seasons; in the external air they appear to increase largely during the summer and autumn months in temperate latitudes; within-doors, in closed-in places and in overcrowded rooms the greatest increase is in the winter, when the numbers are enormously increased, owing no doubt to defective ventilation at this season. As a mean of six years' observation Miquel found, during February, 155 per cubic metre of air at Mont-souris, against 2480 in the Rue de Rivoli; in July, 740 at Mont-souris, against 5205 in the Rue de Rivoli. As other examples he quotes the practical freedom from microbes of the high mountains, as against 79000 per cubic metre found in the Hôpital Hotel Dieu, Paris.

It would appear that in the open air bacteria are diluted and destroyed, whilst in any case the numbers of disease-producing microbes are relatively few excepting when local conditions are such as favour their development.

It would be beyond the scope of the present volume to enter at any detail into the contaminations of air by industrial processes and the impurities incidental to the air of factories,

workshops and mines, &c. But we must notice in particular certain sources of contamination.

(*a*) *Products of Combustion.*

Impurities arising from the products of combustion are important. *Coal* is the material most commonly used as fuel, and the most common source of prejudice to health in connection with it results from smoke. The products of the combustion of coal are carbonic acid, carbonic oxide, in variable quantity as the processes of combustion are incomplete, there being very little with complete combustion; about one per cent. of the coal is reckoned to pass into the air as soot or smoke, but in wasteful misuse of coal, accompanied with excessive and unnecessary smoke probably a much larger percentage is given off. Other impurities in small quantities resulting from the burning of coal are sulphides of carbon and ammonium, and occasionally other compounds of sulphur, and water. The impurities resulting from the combustion of coke and peat resemble those of coal; wood however gives off more water and less of the sulphur compounds.

The products of the combustion of fuels pass directly into the external air, becoming freely diluted and dispersed.

Artificial lighting gives rise to impurities important from the fact that it is seldom that means are provided to convey them into the external air. Moreover in the case of *gaseous* illuminants danger may arise from leakage into occupied rooms from defective pipes or fittings; this is especially to be feared in the case of water gas, which contains a large proportion of the excessively poisonous gas, carbonic oxide. Ordinary coal gas is a mixture produced by the destructive distillation of coal, which is heated in retorts without access of air; water gas is made by passing steam over the heated fuel in a fire-brick

chamber, and by subsequently enriching it with hydrocarbons; it is much cheaper and easier of manufacture than coal gas. The composition by volume of ordinary coal gas, and of a mixture of equal quantities of coal gas and carburetted water gas may be given as follows:

	Coal gas	50 % mixture of coal gas and carburetted water gas
Carbonic Acid	0·7	0·2
Heavy Hydrocarbons	6·2	8·9
Oxygen	0·2	0·0
Hydrogen	46·0	43·5
Methane	36·4	26·9
Nitrogen	4·9	2·2
Carbonic Oxide	5·6	18·3
	100·0	100·0.

The great excess of the very poisonous gas, carbonic oxide, in water gas, and proportionately in its mixtures, is evident.

Various kinds of *oil* are used as illuminants; paraffin is the commonest, and consists of 86 per cent. of carbon, and 14 per cent. of hydrogen; its products of combustion are carbonic acid and water, an ordinary lamp giving off about 0·4 of a cubic foot of carbonic acid per hour.

All of the illuminants already referred to have the effect in varying degrees of raising the temperature, abstracting oxygen from the air, and adding carbonic acid, moisture, and to a small degree, compounds of ammonia, carbonic oxide, and particles of soot.

Of recent years a very largely increased use is being made of *electricity* for illuminating purposes. Without taking other advantages into consideration, the hygienic superiority of this method over the others is very great. The incandescent carbon or platinum thread is enclosed in a small hermetically-sealed globe; there is in consequence no possibility of any

contamination of the air, and the raising of the temperature by this form of lamp is too small to be of importance. The arc light is not enclosed, and is said to cause the formation of nitric acid, but even if this be the case, the amount of impurity is very much less than that from other illuminants, especially gas. Electricity is extensively employed in lighting public and private buildings and offices, hospitals, dwellings &c., and there is no illuminant so well adapted to the requirements of schools when artificial light is necessary.

(*b*) *Emanations from Sewers and Drains.*

The gaseous contents of sewers and drains are of very variable composition. If the sewer is properly constructed, well ventilated, and adequately flushed, the air in it will not vary greatly from that outside; it is in proportion to the neglect of these essentials that sewer gas becomes offensive and injurious; it is when the sewer is allowed to become a sewer of deposit—an elongated cesspool in fact—mischief from stagnating and decomposing sewage results. In these cases there is an increase in the amount of carbonic acid, the oxygen is lessened, fœtid organic vapours and particles collect, as well as varying quantities of marsh gas, sulphide of ammonium, and sulphuretted hydrogen. In closed and sealed cesspools the air is highly impure from these causes. Various micro-organisms, bacilli and moulds are found in sewer air; these however are relatively few, probably because they adhere to the moist surface of the sewer. The effect of breathing the air of rooms to which emanations from sewers and drains find access is distinctly prejudicial, especially so in the case of children; general loss of health, pallor, languor, loss of appetite and diarrhœa, headache and perhaps some degree of feverishness usually ensue and indicate that the aëration of the blood is not being properly carried out; sore-throat is not infrequently

associated with the inhalation of sewage emanations. Children are more susceptible than adults; indeed amongst men working in sewers of good ventilation it is rare to find illness directly traceable to their occupation. Much depends upon the degree of dilution of the sewer gas; cases of extreme and even fatal illness have been associated with the opening of sewers and cesspools which had long been closed, the mischief apparently resulting from the generation of deleterious gases. An atmosphere contaminated with sewer gas, and passing directly into dwellings, will aggravate any form of illness which may exist there, and will always delay convalescence. There appears to be very little doubt that one of the many ways by which the specific poisons of typhoid fever and of diphtheria may find access to the body, is by means of emanations from sewage, either directly by inhalation, or indirectly by pollution of water or food. It must be carefully remembered that the lowered constitution consequent upon breathing sewage emanations predisposes the body to the reception of the poison of zymotic disease, as well as to more severe attacks of the ordinary forms of sickness. Milk and other perishable foods readily decompose if exposed to sewer gas.

(*c*) *Effects of Respiration.*

The commonest and most important impurities in the air of occupied rooms are those associated with respiration, indeed from the point of view affecting the hygiene of schools, the changes in the air brought about by respiration and emanations from the skin are to be regarded as those which most tend to prejudice health. The alterations in the gaseous constituents produced in this manner are very marked; the oxygen is considerably reduced, the proportion of carbonic acid is immensely increased, and there is a trifling change in the proportion of nitrogen; the change is as follows:—

	Ordinary Air per cent.	Expired Air per cent.
Oxygen	20·96	16·40
Nitrogen	79·00	79·19
Carbon dioxide	0·04	4·41

But other very important changes take place besides these; the expired air is warmer than before inhalation, the amount of watery vapour is increased, and it contains certain organic matters of unknown nature. It will be remembered that by the law of diffusion of gases the atmosphere of occupied rooms, so far as the gases are concerned, is maintained at the normal unless ventilation is absolutely interfered with, and if a window be opened the excess of carbonic acid will not accumulate, whilst the abstracted oxygen will be constantly replaced; but diffusion in this sense does not affect either the watery vapour or the organic matter, neither of which can be got rid of except by an adequate ventilation. The actual amount of watery vapour given off in 24 hours from the skin and lungs of each individual varies with the temperature and humidity of the surrounding atmosphere as well as with the amount of work being done; 10 ounces of water from the lungs and 20 ounces from the skin may be regarded as the average amount under average conditions.

"Five hundred children assembled in one room would in the course of two hours give off as vapour about four gallons of water, which would be visible in the clouding of windows and walls, unless the room were well ventilated" (Newsholme).

The exhaled organic matter also contributes largely to the foulness and offensive character of ill-ventilated occupied rooms. On first entering a room of this character from the fresh air the condition is at once appreciated by the sense of smell, but this appreciation is quickly dulled, and after remaining but a short time in the room the offensiveness is unnoticed; the fact that it is unnoticed no doubt explains the toleration of such a condition.

The nature of this organic matter is still uncertain; it is probably in combination with water, and particles of epithelium and fatty matters are associated with it; it presents the ordinary characters of organic matter, decolorising permanganate of potash, darkening sulphuric acid, and rendering pure water offensive, when drawn through them; it blackens on platinum and yields ammonia, and is consequently nitrogenous and oxidisable; the smell is very fœtid.

Exhaled air, then, differs in various directions from ordinary air; in close and confined rooms the exhaled air is breathed and re-breathed over and over again, each time becoming more and more charged with foulness and impurities. Foul odours, increased moisture and raised temperature contribute in a marked and important degree to the discomfort of air from which oxygen has been abstracted, which is vitiated by excess of carbonic acid, and by added volatile organic matter and dust of various kinds; it is this combination which is most favourable to the growth and development of organisms, disease-producing or otherwise.

The consequences of habitually and for prolonged periods re-breathing air fouled by respiration and by exhalations and odours from breath, skin and clothing are very pronounced; as an extreme and gross instance of overcrowding accompanied by fatal results the cases of the Black Hole of Calcutta may be quoted. In minor and ordinary degrees the earlier symptoms are dulness and lassitude, headache and loss of appetite, pallor and anæmia, the effects in the long run proving highly injurious to health. As might be expected the lungs are the organs most frequently affected, and the various forms of tuberculosis such as consumption, phthisis, or scrofula are notoriously associated with the condition, the results being especially marked when deficient exercise and poor feeding are associated with breathing the vitiated air. In former years the prevalence of consumption amongst soldiers both at home and abroad was found by the Sanitary Commissioners for the army to be due

to defective ventilation of barracks and with improved ventilation came the diminution in pulmonary diseases. Contrasts even more pronounced characterise the former and present conditions of prisons. Air fouled by respiration is the cause of tuberculosis not only in man but in animals, cows for example, confined in close ill-ventilated cow-sheds, and the most marked improvement in the health of these animals has followed upon efficient lighting and ventilation of these places.

The more ready transmission of the ordinary zymotic diseases as measles, diphtheria &c., in polluted atmospheres, is due 1st to the more ready growth of the disease-producing organisms in such air, and 2nd to the predisposition brought about by the lowered constitution.

Ventilation and Warming.

The importance of pure air is so generally recognised that it is not surprising that great attention should have been paid to the subject of Ventilation, by which is understood the systematic removal from rooms or occupied places of air vitiated by any cause and in its place supplying fresh air in such quantity and in such manner as will maintain the air of the room at a certain standard without undue draught; this renewal of air must in climates like our own be effected without the unpleasant consequences of draughts which none will willingly submit to; hence the question of warming comes to be closely associated with that of ventilation.

That perfect ventilation is not easy of accomplishment is evidenced by the large numbers of buildings, especially public buildings, theatres, churches, &c., in which the ventilation is anything but successful, notwithstanding the pains which may have been taken to make it so; this may be partly owing to various causes, as popular indifference, inattention, insufficiency of the means employed, or desire for undue economy.

The various considerations involved in Ventilation may be conveniently dealt with in the following order, viz :—

(α) Amount of air necessary.

(β) The means by which this amount may be supplied.

(γ) Tests available to determine whether an adequate standard of purity is maintained.

(δ) Warming.

(a) *Amount of Air necessary for healthy persons.*

It will be sufficiently obvious that under exceptional conditions, associated for example with certain trades, very frequent renewal of air may be necessary and special means may be required to ensure it. But only the ordinary impurities of inhabited rooms are now considered, those evolved from respiration or transpiration, or associated with artificial light.

The index commonly used to determine the degree of vitiation of air, is the amount of carbonic acid present in it; this gas is taken as the index not because the amount present is sufficient in itself to do harm, but for two other good reasons, first, because it is present in a fairly constant ratio with other and more dangerous impurities which have already been alluded to, and secondly, because the amount of this gas present can be ascertained closely enough for all practical purposes without much difficulty.

The air of all occupied rooms must necessarily be less pure than external air, and the question to be answered is, up to what degree is impurity admissible consistent with health; in other words what is the limit of carbonic acid gas which may be allowed, and which if exceeded will result in injury to health?

The supply of fresh air should at all times be such that any observant person entering the room from the external air should not perceive the faintest trace of anything unpleasant to the senses in the way of smell or closeness. A very large

number of experiments and observations have been made at military stations and elsewhere upon the connection between the closeness of the room perceptible to the senses, and the amount of carbonic acid present. Without going into details, de Chaumont's table, which is as follows, may be given:

	1. Fresh, or not differing sensibly from the outer air	2. Rather close. Organic matter becoming perceptible	3. Close. Organic matter disagreeable	4. Very close. Organic matter offensive and oppressive; limit of differentiation by the senses
Mean carbonic acid per 1000 volumes due to respiratory impurity	0·1943	0·4132	0·6708	0·9054

It may be assumed, therefore, that when the carbonic acid of an occupied room does not exceed 0·2 per 1000 vols. *from respiratory impurity*, there is no difference apparent to the senses between the atmosphere of the room and the external air, but if this amount is exceeded, the closeness and oppressiveness increase in proportion up to 0·9 vols. of carbonic acid per 1000, beyond which differentiation by the senses is no longer possible. The limit, therefore, of admissible respiratory impurity in an occupied air-space has, therefore, been fixed at that indicated by the presence of 0·2 per 1000 vols. of carbonic acid; beyond this it ought not to go. Increased warmth and moisture render the offensiveness noticeable with the lower proportions in the scale, owing perhaps to decomposition. It must, however, be carefully remembered that the carbonic acid in the room will escape, owing to diffusion, much more rapidly than the organic matter and vapour which is not affected in this way.

The next point to determine is the amount of carbonic acid given off by each occupant of the room; this depends somewhat upon the weight and activity of the person. Upon Pettenkofer's observations, 0·6 of a cubic foot of carbonic acid is given off per hour, as an average of a mixed community; children, averaging 80 lbs. weight, giving off 0·4 of a cubic

foot. Upon this standard, therefore, if 0·2 per 1000 cubic feet is the limit of admissible respiratory impurity, and 0·6 cubic foot is evolved per hour, this amount must be diluted three times to maintain the requisite degree of purity; in other words, 3000 cubic feet of fresh air must be given per hour for an adult, and 2000 cubic feet for a child in order to maintain the standard which is now universally regarded as the proper one. This is the amount which is requisite in health; the necessary allowance in hospitals is much larger.

With regard to lighting, it is always desirable that the products of combustion of coal-gas should not be allowed to escape into school rooms, dormitories or other occupied places. Speaking generally, the ordinary gas burner consumes five cubic feet of coal gas per hour, generating about three cubic feet of carbonic acid, and it requires practically the same amount of fresh air supply as an adult; hence the number of gas burners must always be taken into account in estimating the amount of air required for rooms. The advantages of the electric light, which does not add impurity to the air, are very great.

It will be remembered that not only carbonic acid gas and organic and inorganic impurities, but watery vapour, exhaled or from other sources is removed in the process of ventilating the room.

(*b*) *Amount of Cubic Space necessary.*

The necessary amount of cubic space requires careful consideration. Since an adult requires 3000 cubic feet of fresh air per hour, and a child somewhat less, the cubic space must be such that this amount can be supplied without changing the air so often, or in such a manner as to cause draught and its consequent injurious effects. In churches, theatres and all such places, where people are habitually congregated for several hours at a time, the cubic space is a matter of the highest

importance on this account, but nowhere is it of greater importance than in schools; no class of persons is so intolerant of draughts as those of sedentary habit or occupation.

The following table taken from Notter and Firth's work on Hygiene indicates the quantity of air per head per hour required to pass through spaces of various sizes, in order that the contained air shall be kept within the limit of admissible added respiratory impurity, *i.e.* that the added carbonic acid shall not exceed 0·2 vols. per 1000:

Amount of cubic space (=breathing space) for one person in cubic feet	Ratio per 1000 of CO_2 from respiration at the end of 1 hour, if there has been no change of air	Amount of air necessary to dilute to standard of 0·2 during the first hour	Amount necessary to dilute to the given standard every hour after the first
100	6·00	2900	3000
200	3·00	2800	3000
300	2·00	2700	3000
400	1·50	2600	3000
500	1·20	2500	3000
600	1·00	2400	3000
700	0·86	2300	3000
800	0·75	2200	3000
900	0·67	2100	3000
1000	0·60	2000	3000

The amount necessary to dilute the impurities to the accepted standard every hour after the first, is 3000 cubic feet; it is found, however that under the ordinary conditions of this climate, but especially in cooler weather, the renewal of air three times per hour is all that can be borne with comfort in ordinary rooms, a more frequent renewal than that, for example, five times per hour in a 600 cubic feet space, becomes perceptible and causes the sensation of draught.

It follows, therefore, if the estimates given be correct—which there is no reason to doubt—that for continuous occupation, the cubic space necessary per head is about 1000 cubic

feet, and the air in it should be renewed three times per hour. If the air can be suitably warmed before it is introduced, so that the current shall not be objectionable, a smaller space will suffice if it is associated with a more frequent renewal. It may be mentioned that these allowances relate only to the healthy; in cases of sickness, more especially infectious sickness, and in hospitals, &c., a much larger allowance of air and space is necessary.

In schools, dormitories, barracks, public meeting places, as well as in the dwellings of people below the middle class, the ideal 1000 cubic feet of space per head is not attainable. Houses of artizans and labourers have about 200 cubic feet available; in barracks, 600 cubic feet are allowed, poor-houses and common lodging-houses have 300 to 350 cubic feet, only half of that amount being demanded in the case of children under ten. In school-rooms, the Education Department require a minimum of 80 cubic feet and 9 square feet of floor space in infant schools, and the accommodation for elder children is subject to a minimum of 10 square feet being provided; wasted space is not considered.

Cubic space cannot of course take the place of change of air; the table quoted indicates that in the largest air space, the air requires renewal after a limited time just as in a small one.

(c) *Supply of Fresh Air.*

The *Source* of the air supplied must in all cases be a pure one, and contamination during the course of supply must be avoided; warming or cooling may be necessary according to season, and the attainment of uniformity of diffusion through the room must be kept in view. Means for the abstraction of foul air are properly provided near the top of the room.

The Forces concerned in ventilation, are diffusion (see p. 17), winds, and the changes arising from varying temperatures; by *natural ventilation* is understood that these forces act alone,

without mechanical apparatus; by *artificial ventilation* is understood that the action of natural forces is modified by mechanical means.

Winds may be the most powerful ventilating agent, either by directly blowing through the room, or by means of *aspiration*, as when blowing over the chimneys a current of air is then caused up the chimneys at right angles to the course of the wind.

The uncertainty of the force of the wind prevents reliance being placed upon it.

Varying temperatures cause changes in the weight or density of volumes of air and consequently give rise to movement; it is to this cause that winds are due, but the same changes play an important part in the ventilation of ordinary rooms—if the air of a room be warmed it will expand and some of it will escape, and what remains will be lighter than the air outside, which will find its way in until the weight of air inside and out is equalised again.

All methods of ventilation aim at admitting enough fresh air to remove all closeness, without causing draughts; in warm, summer weather, windows placed in opposite sides of the room and open at the top may be relied on for the purpose, but under ordinary conditions, special arrangements of inlet or outlet shafts or openings are necessary; with long shafts there is considerable loss of velocity of the current owing to friction, and bends and turns also have the effect of checking the force of the current, a turn of a right angle diminishing it by one half. Hence angles should be avoided as much as possible in the course of the shaft and the shaft itself, with the object of lessening friction, should be circular rather than rectangular.

Natural ventilation is effected in the simplest manner by open windows, a method, however, which is only available in warm weather. Special inlets and outlets which are ordinarily provided, best ensure distribution if numerous and small, say 48 to 60 square inches, rather than few and large.

Inlet tubes should be short, easily cleaned, and, if warmed, placed low down; if the air is not warmed the current is best admitted at a height of 9 or 10 feet, and directed upwards to avoid draughts. In towns the air can be *filtered* by a piece of muslin drawn across the opening, which effectually prevents the entrance of blacks and dirt. Hinckes Bird's simple device for natural ventilation is to raise the lower sash of the window a few inches, and fit in a block of wood below it, so that fresh air is admitted through the opening between the upper and lower sashes only, and the force of the current is broken and directed upwards. Other simple inlets may be mentioned, such as Ellison's bricks, perforated with conical holes, the small end outside; Tobin's tubes; louvres; Sherringham valves; Cooper's discs, &c.

Outlets should be placed high up, if there are no means of heating the air passing through them; they should be straight, smooth, enclosed in walls to prevent the air being cooled, and covered above in a manner which will aid the aspirating power of the wind, check down-draughts, and exclude rain. The reliability of outlets is increased with artificial warmth; the ordinary chimney with open fire will meet ordinary requirements, and this may be more fully utilised by the construction of shafts around it, their openings being near the top of the room. Arnott's valve is an outlet valve, it is usually placed high up in the wall and is constructed to swing towards the chimney, closing against down-draught, the flaps are of talc or metal.

Artificial ventilation. Heat, steam-jets, fans, pumps, &c., are the means commonly employed in artificial ventilation. When the fresh air is driven in so as to force out the foul air, the method is known as *propulsion* or *plenum;* if ventilation is effected by drawing the foul air out, the method is *extraction* or *vacuum.*

The common chimney is the most familiar example of extraction by heat, the current up it being 6 to 9 feet per

second, all other openings in the room being inlets; if the inlets are insufficient, down-draughts are caused. Lighted gas, suitably placed in a shaft in the ceiling, may be made a very efficient means of extraction. Fans may be used either for extraction or propulsion; the Blackman air-propeller is considered one of the most efficient.

Both methods, extraction and propulsion have advantages and disadvantages; with extraction the amount of current varies with the degree of heat; in the case of large buildings, the rooms nearest the shaft will have a strong current, whilst those at a distance from it will have little or none; the possible reversal of the current with this method must not be lost sight of. With propulsion there is more certainty in amount, and greater ease with which that amount can be supplied, moreover the purity of the intake can be assured. There is, however, usually greater cost, and possibility of breakdown to be remembered, and careful attention to detail is always necessary with this system.

Schedule VII. of the Code of Regulations of the Education Department contains the following rules to be observed in planning Public Elementary Schools :—

"Apart from open windows and doors, there should be provision for copious inlet of fresh air; also for outlet of foul air at the highest point of the room; the best way of providing the latter is to build to each room a separate air chimney carried up in the same stack with smoke flues. An outlet should have motive power by heat or exhaust, otherwise it will frequently act as a cold inlet. The principal point in all ventilation is to prevent stagnant air. Particular expedients are only subsidiary to this main direction. Inlets are best placed in corners of rooms furthest from doors and fireplaces, and should be arranged to discharge upwards into the rooms. Inlets should provide a minimum of 2½ square inches per child, and outlets a minimum of 2 inches. All inlets and outlets should be in communication with the external air.

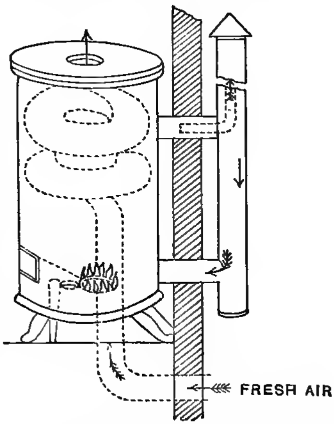
Rooms should, in addition, be flushed with fresh air about every two hours. A sunny aspect is especially valuable for children, and important in its effects on ventilation and health."

Warming.

Warming is closely associated with ventilation. There are three ways in which heat is distributed, viz. :—(α) by *radiation*, in which the heat given off by the warming object, e.g. burning coal in an open grate, is propagated in straight lines, with equal intensity in all directions, but with an effect which diminishes as the square of the distance increases; this method is no doubt wasteful, but at the same time it is the natural one and the most pleasant, being typified in the warmth of sunshine; the open grate and the sun warm in the same extravagant but agreeable fashion. (β) *Conduction* is another well-known form of distribution of heat; it consists of the more or less slow passage of heat through certain solids; a familiar illustration is furnished when a silver spoon is used in hot liquid, it soon becomes warm throughout by the conveyance of heat from particle to particle of the spoon until the whole is affected; similarly if one end of a metal bar be thrust into the fire and allowed to become red hot, the other end becomes hot by the process of conduction. Conduction incidentally plays an important part in warming rooms, as for example when the ironwork, or other solid conducting structures around grates and stoves become hot by this means. *Liquids* and *gases* are bad conductors, but heat is distributed in them in the third manner, namely by *convection*. By convection is understood the fact that the particles of gas or liquid expand as a consequence of being heated, become lighter, and rise, their place being taken by colder and consequently heavier ones; if a vessel containing water be heated, and a few fragments of cochineal dropped into it to

indicate the currents, it will be seen by appropriately placed thermometers that the warm particles of water ascend in the centre, while the cold ones descend by the sides. The atmosphere like all other gases readily expands by heat, consequently convection is very marked, and convection currents are important adjuncts in warming.

Ordinary dwelling rooms in this country are almost invariably warmed by open fires, a method to be commended as not only cheerful but healthy on account of the ventilation ensured by it. In the case of large rooms such as schoolrooms this means cannot be regarded as efficient since about 75 °/ₒ of the available heat from the combustion of fuel is with the ordinary open fire-place lost up the chimney. Various measures however are taken to construct grates so that combustion shall be slow and fuel economised, the points aimed at are (1) to use fire-brick instead of iron, (2) the fire-place should be narrow, the back leaning slightly forward over the fire, (3) beneath the fire the space should be closed in front by a close fitting shield. Suitably placed central stoves with open grates such as Boyd's can be sometimes used, the flues from which pass under the floors. In halls and vestibules stoves are sometimes employed to warm the fresh air as it passes in from without; George's Calorigen stove is upon this principle, which is sufficiently explained by the diagram. Many adaptations of this principle are in use. Stoves which do not provide means for the inlet of fresh air as



George's "Calorigen" Gas Stove.
Fig. 7.

well as for the removal of the products of combustion should be excluded, and it is unnecessary to say that any stove which is liable to become over-heated should be condemned.

Hot-water pipes constitute one of the simplest and best means of warming schools; the pipes are usually from 2 to 4 inches in diameter and are connected with a boiler usually placed in the basement; they are arranged in a double row to allow the water circulating.

The temperature in school-rooms should be kept at about 56° to 60° Fahr.; if the corridors, lobbies etc. are also warmed by pipes this degree is more easily maintained. Warming by means of hot-water pipes can with great advantage be supplemented by open grates, which can be used occasionally, and their flues are always available for ventilating purposes.

Fig. 8 indicates the method of warming and ventilation of a large Board School. The fresh-air inlet is shown on the left (A), the air is warmed at (B), filtered at (C), and following the direction of the arrows, passes through the class-rooms and is extracted at the shaft (K), connected with the boiler-house (L).

Lighting is dealt with in connection with *structure* and *arrangement* of school furniture in Part II.

NOTE. Mr Bailey, of Owens College, Manchester, has supplied the following figures illustrative of tests carried out in connection with Ventilation of School and other public buildings:

Class-room in Public Elementary Schools in Manchester in June and July gave a range of 11 *to* 15 *parts* CO_2 in 10,000.

The Chemical Laboratory at University College, Nottingham, 7 *parts* CO_2.

A Committee Room of the same College (27 jets of gas burning), 42.

A Theatre at Leeds, gallery, 14.

Chancery Court, London, 20.

Standard Theatre, London, E., 32.

Air of normal standard indoors may be taken to show 6 parts.

Expired air, at temp. 98° Fahr., 470 parts.

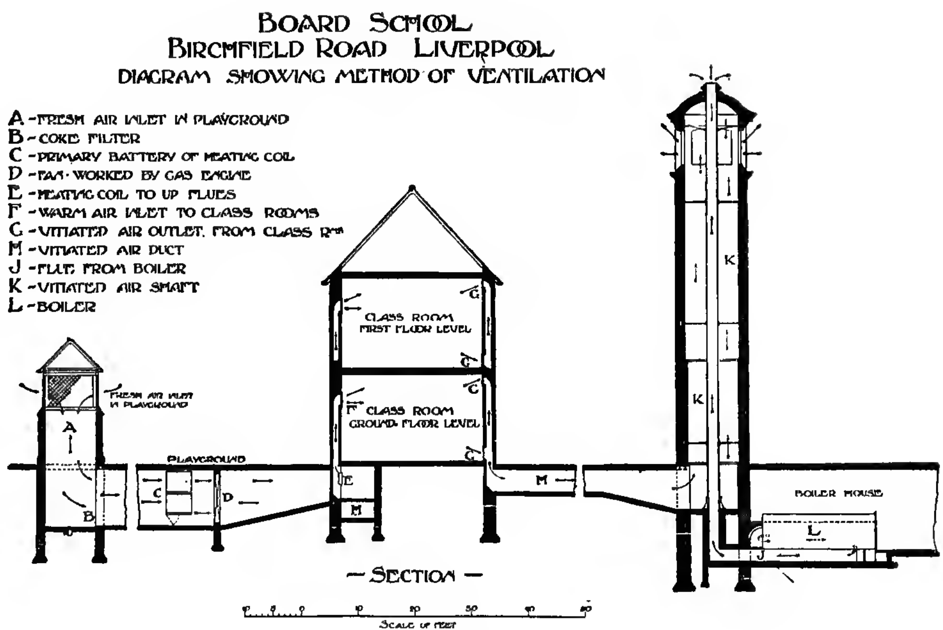

BOARD SCHOOL
BIRCHFIELD ROAD LIVERPOOL
DIAGRAM SHOWING METHOD OF VENTILATION
A - FRESH AIR INLET IN PLAYGROUND
B - COKE FILTER
C - PRIMARY BATTERY OF HEATING COIL
D - FAN WORKED BY GAS ENGINE
E - HEATING COIL TO UP FLUES
F - WARM AIR INLET TO CLASS ROOMS
G - VITIATED AIR OUTLET FROM CLASS R^MS
H - VITIATED AIR DUCT
J - FLUE FROM BOILER
K - VITIATED AIR SHAFT
L - BOILER
FRESH AIR INLET IN PLAYGROUND
PLAYGROUND
CLASS ROOM FIRST FLOOR LEVEL
CLASS ROOM GROUND FLOOR LEVEL
BOILER HOUSE
— SECTION —
SCALE OF FEET

Fig. 8.

CHAPTER IV.

FOOD AND CLOTHING; SOME ESSENTIAL FACTS FOR THE GUIDANCE OF THE TEACHER.

1. *Food and Diet.* Foods are substances which are capable of undergoing such changes in the digestive organs as will render them capable of absorption into the circulation, and of serving one or other of the following purposes, viz. :—

(*a*) of renewing the tissues and the organs of the body,

(*b*) of supplying material for the maintenance of their functions.

In other words they are either tissue producers or force producers, but most of the ordinary articles of diet contain both materials, although in unequal proportions, and ordinary articles are therefore to a certain extent contributory not only to the growth, maintenance, repair, and functional activity of the tissues, but also to the production of heat and force. Water also enters largely into the compositions of all foods, and it is essential to their assimilation; a certain quantity of salts is also present in foods. Besides foods proper, certain food accessories are in constant use, such as tea, coffee, alcohol, condiments, &c. Organic food-stuffs admit of a division into the nitrogenous, and the non-nitrogenous. The nitrogenous, as the name implies, contain nitrogen; their function is mainly that of providing for growth, maintenance, and repair, and

only in a minor degree do they contribute to the production of heat and force. As a common illustration of the various kinds of nitrogenous food-stuffs may be mentioned (1) egg albumen, (2) myosin, the chief constituent of meat, (3) casein, from milk in cheese, (4) legumin, from peas, beans, &c., (5) gluten, in cereals, wheat, bread, (6) peptones, which include the foregoing after they are rendered diffusible and non-coagulable by heat, by the gastric juices. The non-nitrogenous food-stuffs include the fats or hydro-carbons, and also the starches and sugars or carbohydrates. These contain no nitrogen, and are used up in the production of heat and force, or in the formation of fat in the body. Water and the inorganic salts are essentials in all diets.

It is obvious, therefore, that a variety of the ordinary food-stuffs is necessary to maintain health and life, and the actual diets taken by an individual include very complex mixtures. Actual diets and dietaries vary in accordance with the age and sex of the individual, with the climate and temperature, with rest and work, as well as with individual tastes and idiosyncrasies.

Standard diets have been compiled for the use of schools, hospitals, and so forth, but it is abundantly plain that what is enough in the case of one child would be too much for another, and *vice versâ*. Roughly speaking, the average diet of an adult in 24 hours would comprise 4 to 4½ ozs. of nitrogenous food (meat), 3 ozs. of fat, 15 ozs. of sugars and starches, &c. and 1¼ ozs. of salts. The average child would probably take about three-fifths of that amount, but the fats and the starches would be increased somewhat in cold climates, and this estimate does not include the food accessories.

It must be remembered that during childhood, growth and development of the nervous, muscular, and bony tissues, call for an adequate food supply, and this would indicate an addition to what is wanted merely to maintain the equilibrium of the body. Milk, which is considered by some as the type of a perfect food for children, contains :—

Casein	4·0%
Fat	3·7%
Sugar	4·8%
Salts	0·7%
Water	86·8%

The probability is that milk is too dilute a food for average children of the school age.

A most important point in connection with foods is their digestibility. It is perfectly obvious that good food, unless prepared in such a way as to be digestible and attractive, loses much of its usefulness. For example most people have a practical acquaintance with the relative digestibility of tough meat and tender meat. A point of equal importance is that the meals should be suitably divided; excess at any time is bad. Sleep diminishes digestion, therefore late and heavy suppers should be avoided, and the reason why they cause sleeplessness is that the digestive system is given work to do at a time when it also wants sleep. It must also be remembered that active mental work immediately after a meal will retard digestion. Alcohol should never be given to children excepting as a medicine and under the advice of a medical man.

2. *Clothing.* The object of clothing is to protect the body against heat or against cold; in other words to maintain an equable and uniform temperature of the body, the normal being 98·4 degrees Fahrenheit.

Clothing, whilst it prevents radiation and conduction of heat, should not interfere with the evaporation of perspiration, and hence the materials and the make of the garments require consideration.

First with regard to the *Materials*, those most commonly used are cotton, linen, wool, silk, leather and india-rubber, all possessing certain microscopic and chemical characters.

Cotton in its microscopic characters consists of minute riband-like fibres. The fibre is exceedingly hard, and in an article of dress wears well, does not shrink in washing, and is very non-absorbent of water, and is cheap and durable. It is very absorbent of odours. It conducts heat less rapidly than linen, but much more rapidly than wool.

Linen has fine cylindrical fibres with little swellings at regular intervals; it conducts heat very readily and hence feels cold to the touch, and hence the feeling of coolness of linen sheets; it absorbs water slightly better than cotton, with which it may be classed as an article of clothing. Cambric and lawn are fine varieties.

Wool, a modification of hair, consists of round fibres which break up into fibrillæ when old and worn; it is a bad conductor of heat, and a great absorber of water, which penetrates into, and distends the fibres themselves and also lies between them, hence it is greatly superior to cotton and linen as an article of clothing. Evaporation of perspiration during exercise reduces the heat generated by the exercise; evaporation however continues after the exercise, and the vapour from the body is condensed in a woollen garment and the large amount of heat which became latent when the water was vaporised is given out again. The non-conducting character of wool makes it warmer as an article of clothing. It should always be worn next the skin, but it is needless to point out that in summer the woollen garment should be an exceedingly thin one; the disadvantage of wool is the way in which the soft fibre shrinks, hardens, and becomes less absorbent after frequent washing.

Leather should be well tanned and supple; coats of sheep-skin and other skins are exceedingly warm and are of use in intensely cold and windy climates; the use of *india-rubber* as a protection from wet is good; it should not be used except as a temporary protection against wind and rain.

Silk consists of minute filaments and is the strongest and

most tenacious of textile fabrics; it approaches wool, rather than linen or cotton in its conducting and absorbing capacities.

Clothing should never fit so tightly as to constrict; loosely fitting clothes are more comfortable and warmer, as they imprison the air. Tight gloves will produce chilblains. Braces should be worn rather than belts or garters. Young children should be properly covered in cold weather; bare arms, chests, and legs should be avoided. Children should never be allowed to sit in damp clothes. Frequent changes of underclothing are necessary, and things worn by day should never be slept in at night.

Boots should have thick, damp-proof soles, low heels, and should fit comfortably.

CHAPTER V.

SICKNESS.

APART from the general hygiene of the scholar, the Head Teacher of a school has to take special account of the kinds of sickness which are liable to occur in epidemic form.

The code of the Regulations of the Board of Education provide, as one of the conditions necessary in order that a Public Elementary School should obtain an annual parliamentary grant, that "The managers must at once comply with any notice of the sanitary authority of the district in which the school is situated, or any two members thereof, acting on the advice of the Medical Officer of Health, requiring them for a specified time, with a view to preventing the spread of disease, or any danger to health likely to arise from the condition of the school, either to close the school, or to exclude any scholars from attendance, but after complying they may appeal to the Department if they consider the notice to be unreasonable."

Article 83 (a) prescribes that "if a school has been closed under medical authority, or for any unavoidable cause, a corresponding reduction is made from the number of meetings" (400 a year) required.

Article 101* provides that where the Education Department "are satisfied that by reason of a notice of the Sanitary Authority under Art. 88, or any provision of an Act of Parliament, requiring the exclusion of certain children, or by reason of the exclusion under medical advice of children from infected houses, the average attendance has been seriously diminished, and that consequently a loss of annual grant would, but for this Article, be incurred, the Department have

power to make a special grant not exceeding the amount of such loss in addition to the ordinary grant."

It will be seen that the ailments which may lead to the closure of the school, or the exclusion of the scholars therefrom, are not limited to diseases scheduled under the Infectious Disease (Notification) Act. In fact quite apart from actual illness amongst the scholars, there is a phrase "or in danger to health likely to arise from the condition of the school."

The diseases on account of which it is most usually necessary to exclude scholars, or close schools, are those which spread directly from person to person, such as Scarlet Fever, Measles, Diphtheria, Whooping Cough, Small Pox, Typhus Fever, and it is also very commonly necessary to exclude pupils coming from homes in which Typhoid Fever, or certain forms of Choleraic Diarrhœa exist. One reason, in the case of Typhoid Fever, being the risk of contamination of the closets by a child in an incipient stage of the illness.

In all forms of acute illnesses, which may possibly develop into Infectious Disease, it is desirable to exclude scholars coming from houses where sickness is until it is clearly ascertained that the disease is not an infectious one. It must be remembered that in their early phases some forms of infectious sickness are frequently obscure and difficult to diagnose, consequently it is better that the error should be on the side of safety, and the child excluded if the circumstances of illness at home are doubtful.

Very frequently teachers will be the first persons who have the opportunity to notice symptoms of illness of a pupil. A change in the normal disposition of the child, abnormal irritability, drowsiness, or inattention, are commonly associated with impending illness; hot and dry skin, accompanied perhaps with shivering; shrunken and dusky, or flushed appearance of the face; complaint of headache, sore-throat, diarrhœa or pain, should be carefully observed by the teacher, and the pupil should temporarily be taken from the class for medical exami-

Ringworm, scabies, and ophthalmia may last indefinitely unless properly dealt with, and no child with any trace of these diseases should be admitted to school.

As regards the influence of school closure upon the prevalence of sickness, as indicated by the numbers of cases reported to the Medical Officer of Health, it is interesting to note the experience of the last four years in Liverpool in regard to Measles among children attending elementary schools. The subjoined table indicates the number of cases reported during one month *before* the holidays, and one month *after* the holidays, precisely the same machinery for notification being in force in each period. It would also appear that the longer the holidays the greater the effect in lessening the prevalence of the sickness.

Summer holidays		Cases of measles reported	Winter holidays		Cases of measles reported
1896.	During one month preceding the holidays	283	1896.	During one month before the holidays	143
	One month after the holidays	35		One month after the holidays	115
1897.	One month before the holidays	991	1897.	One month before the holidays	403
	One month after the holidays	131		One month after the holidays	171
1898.	One month before the holidays	452	1898.	One month before the holidays	205
	One month after the holidays	137		One month after the holidays	75
1899.	One month before the holidays	1325	1899.	One month before the holidays	501
	One month after the holidays	182		One month after the holidays	217

Average of 4 years.

One month before the holidays	737	One month before the holidays	312
One month after the holidays	121	One month after the holidays	144

nation if necessary. These observations are specially necessary during times of prevalence of infectious sickness, the onset of which is commonly attended by one or more of the symptoms alluded to; those first named are practically common to them all, but during times of prevalence of Scarlet Fever or Diphtheria, every case of sore-throat is to be looked upon with suspicion, and children with rashes on the skin should be promptly separated from the class.

The importance of attention to these matters will be more apparent when it is remembered that when an infectious disease has been contracted a period of incubation ensues, of varying duration, before any symptom of illness is manifested by the infected person. Hence, when a child has been exposed to infection it is unsafe for that child to mix with others until it is evidenced by expiration of the period of incubation that the child has not been affected.

The period of incubation and the average duration of infectivity of the commoner forms of infectious disease are as follows, but it is desirable that exclusion from school should not be limited to minimum periods, but continued for 14 days after disinfection has been completely carried out by a competent authority, or until, of course, the child is strong enough to resume school work.

	Average incubation period	Average duration of infection from commencement of illness	
Scarlet fever	4 days	5 to 8 weeks	
Diphtheria	4 ,,	3 ,,	
Measles	12 ,,	3 ,,	
Whooping cough	14 ,,	7 ,,	
Typhus fever	10 ,,	5 ,,	
Typhoid ,,		5 ,,	
Rötheln	8 ,,	3 ,,	
Mumps	14 to 21 ,,	4 ,,	
Smallpox	12 ,,	4 to 12 ,,	varying as the disease has been modified by vaccination
Chickenpox	12 ,,	6 ,,	

The Summer holidays extend to about five weeks; the Winter holidays from a fortnight to three weeks.

With reference to the grounds upon which scholars should be excluded from school, it must be admitted,

(1) That all children suffering from an infectious disorder should be excluded from school so long as they are likely to retain any infection; this condition is one which may involve exclusion for some time after the patient is apparently convalescent.

(2) In general practice it is equally necessary that children coming from houses, any inmate of which is suffering from infectious sickness, should also be excluded, because in the great majority of instances, if not in all of them, it is impossible to effectually isolate a case of infectious sickness in an ordinary household, especially within the homes of children of the class who attend the public elementary schools.

Hardship really is minimised by a careful application of the powers to exclude individual scholars, because unless this is attended to it is quite possible that disease may rapidly spread to an extent which would render it necessary to close the school altogether.

It must not be forgotten that the Sanitary Authority of every town and of most rural districts has provided hospitals for the isolation of those suffering from infectious disease, and if the patient is removed to hospital, and the house, &c., disinfected, attendance at school may be resumed by children living in the house much sooner than if the patient remains at home throughout the entire illness.

The closing of schools may seriously interfere with the educational work of the locality, and is a step which should only be taken after the most careful consideration of the circumstances, and upon evidence that extension of disease will be checked by it.

The character of the evidence that the school is the centre of infection must be carefully weighed, and the nature of the

action to be taken will necessarily vary under different conditions. If, for example, a serious and formidable form of disease is found to be spreading amongst children living at such distances apart as to render it improbable that they had any other means of communication than that involved by attendance at school, grounds would be furnished for the suspicion either that some coming from an infected house were disseminating the disease, or possibly that a child actually in an infectious condition was attending the school. Localised outbreaks of typhus fever, for example, a most formidable and dangerous disease, have been definitely traced to these causes, and it must be remembered also that even if other possible opportunities for infection exist, such as would arise in playing together or going to one another's houses, it must be borne in mind that the relationships are less intimate than when in school.

It is extremely difficult, if not impossible, to lay down definite rules as to when, and for how long a time, schools should be closed. The nature of the disease, its character, the numbers of the pupils affected, will all be factors in determining the point, as well as the nature of proof that the sources of infection are actually at the school.

It is plain, for example, that if 10 % of the children attending a school are absent on account of typhus fever, the aspect is more grave than if the same number of children are absent from measles, and the more formidable character of the one form of disease would call for more stringent action than in the case of the other; yet in either case it would be necessary to adopt as rigorous means as possible to exclude scholars from infected houses in the first instance, and it would probably be found in that way that the disease would be checked without resorting to closure of the school.

Much depends upon the amount and the promptness of the information which the Medical Officer of Health is able to gain in regard to the circumstances of the school children and

their homes: and the promptness with which action can be taken.

Closure of schools is less likely to be efficacious in checking diseases such as measles in a densely populated district than in a sparsely populated one, because the opportunities for intercommunication in other ways are much greater in the densely populated district than in the rural one, where children live at greater distances and are less likely to meet together apart from schoolroom meetings.

The existence of infectious disease in a locality is by no means *per se* to be looked upon as a ground for closing the schools, and again still less is the existence of isolated cases of sickness amongst the pupils.

What applies to public elementary schools (Board Schools and Denominational Schools) also applies to Sunday Schools and private schools. Although these latter establishments are not subject to the same regulation by the Sanitary Authority as the others, yet the Public Health Act does make certain provisions which are applicable to schools of every kind, and the managers of these establishments are as a rule perfectly willing to act upon the suggestions which the Sanitary Authority may find it necessary to offer.

When it does become expedient to close schools it is desirable that the time specified should be a minimum, because if it appears necessary a notice extending the period can be given before the expiration of the time originally stated.

It will be of interest to describe the details of the practice current in an English city, taking our illustration from the City of Liverpool.

The object aimed at is of course to give the earliest possible information to the Head Master, or Head Mistress, or Principal, when sickness exists at the homes of the scholars.

Usually the first intimation is received by the Medical Officer of Health, under the terms of the Notification Act,

which requires that notice be given to the Medical Officer of Health of the occurrence of Infectious Disease by,

(*a*) the head of the family to which the patient belongs, and in his default,

(*b*) by the nearest relatives present in the building and in attendance on the patient, and in their default,

(*c*) by every person in charge of, or in attendance on, the patient, and in default of any such person,

(*d*) by the occupier of the building (as soon as he becomes aware that the patient is suffering from an Infectious Disease).

(*e*) Every Medical Practitioner attending on or called in to visit the patient is required forthwith, on becoming aware that the patient is suffering from an Infectious Disease, to send a Certificate to the Medical Officer of Health stating the name of the Patient, the situation of the building, and the Infectious Disease from which, in the opinion of the Practitioner, the patient is suffering.

The Notification Act, however, does not include measles and whooping cough, both of which are liable to spread extensively amongst children of school age; these will be subsequently alluded to.

When notification of infectious sickness is received by the Medical Officer of Health from the medical attendant under the terms of the Infectious Disease (Notification) Act, the address of the patient and the nature of the illness are entered in a register specially made for the purpose and which passes each day to the District Sanitary Inspectors' office. There it is examined by each of the District Inspectors, who takes note of such addresses as are on his own district, which he initials, and he becomes responsible for ascertaining and reporting the names of any children of school age who may be living at the address in question, the school they attend, and the various matters which require to be dealt with in connection with an infected house. It is part of the Inspector's duty to warn the

parents or those in charge that the children must be kept from school until fourteen days after the necessary disinfection has been carried out; he leaves a postcard, addressed to the Medical Officer of Health to be filled up and forwarded by the parent or other responsible person as soon as the doctor in attendance states that the disinfection may be carried out.

Case of..

No. of House..*Street.*

Date for Disinfection..

Signature..

On returning to the central office next morning each inspector copies from his daily work book on to a sheet the date of his visit, nature of disease, address and names of children, and school they attend, in accordance with the subjoined form:

Date 190...		Disease	Address		Names of Children	Schools where Children attend	REMARKS
			No.	Street			

This information is duly entered in a permanent register under corresponding headings.

Intimation is sent by postcard the same day to the Headmaster of the School the children attend if it is a Board School (or to the Principal in the case of a Private School).

The permanent register in which the names have been entered is then passed on to the Clerk to the School Board,

who causes the various entries to be copied by his staff into a book having appropriate headings, as follows:

DATE		STREET	NAME

No.	SCHOOL	SICKNESS			DISINFECTION			Date when School was notified of Disinfection		
		Inspector notified of Sickness		Disease	Date of Disinfection	Inspector notified of Disinfection				
		Date	Initial			Date	Initial			

There are four of these books, to correspond with the four districts into which the city is divided for school purposes.

An intimation on the subjoined form is then given to the School Visitor warning him that the children from the address indicated thereon are prohibited from attending school until further notice is sent to him.

SICKNESS. Date,..1901

Disease.. *District*..........................

Street..

Name...

Name...

School..

MUST NOT ATTEND THE SCHOOL.

When the source of infection is removed (either by removal of the patient to hospital, or by the recovery or death of the patient) the house and bedding are disinfected by the officers of the Public Health Department. These proceedings are duly recorded in a register called the Disinfecting Book, which is passed on to the Clerk to the School Board in the manner already described.

At the expiration of a fortnight from the date of disinfection the School Visitor is notified to visit the house, and if no sickness of any kind has occurred in the interval he reports accordingly, and the following day intimation is sent by post-card to the Head Teacher of the School to re-admit the children.

[52.] [No. .]

Liverpool School Board.

....

The House No...

....

having been duly disinfected a fortnight since, I have the authority of the Medical Officer of Health for saying that it will now be safe for you to re-admit..

....*to your School.*

Municipal Offices, *Yours faithfully,*

..............................*1901* EDWARD M. HANCE,
CLERK.

Information is received by the Medical Officer of Health of diseases not included under the Notification Act from School Visitors, teachers, parents, and others, who are supplied with

printed postcards suitable for the purpose, and each District Sanitary Inspector initials the address situated in his district, and reports the names of the children, &c., in a similar manner to that followed in the case of diseases included under the Notification Act.

In the case of Measles and Chicken Pox disinfection is carried out with the consent of the occupier of the house; the children are not allowed to return to school until a fortnight after the sickness has ceased to exist.

In cases of Whooping Cough, Ringworm, &c., only the affected child is kept from school.

The postcards sent to the school, for the purpose of notifying the existence of infectious disease at a house, are accepted by the Government Education Department, also by the Liverpool Council of Education, as a valid reason for the non-attendance of the children at school, and qualify them to receive any benefits which regular attendance would have entitled them to.

It must be borne in mind that the methods now described are directed to the suppression of infectious disease, and although the child may be free from infection, and therefore, so far as the risk of infection is concerned, may with perfect safety return to school, yet it must be remembered that the child may not be sufficiently recovered physically to undertake at once the full work and discipline which attendance at school entails.

The permission of the Health Department to return to school therefore implies nothing further than freedom from infection.

CHAPTER VI.

PERSONAL ASPECT OF INFECTION.

It is sufficiently evident that no child in indifferent health, or suffering from illness of any kind, should be allowed to attend school, but in the case of *infectious* sickness the reasons for its exclusion do not apply only to the *sick* child, but to the rest of the scholars. It is, therefore, of paramount importance that children suffering from infectious sickness should be at once excluded, and *serious* responsibility rests upon those in authority to effect this exclusion.

It may be well, therefore, to describe briefly the more prominent symptoms of those forms of infectious sickness commonly met with amongst children in this country.

In all forms of infectious sickness a period of *latency* precedes the commencement of the illness, that is to say, after the germs of infection have entered the body, the patient remains in apparently perfect health for a certain length of time which varies with the nature of the illness.

Thus, a child who on being exposed to scarlet fever contracts that disease, will show no sign of illness whatever until about four days later, whilst a child which has been exposed to measles will show no sign of illness for about 12 days. As soon as this period of latency is over, symptoms of illness manifest themselves: the child is usually fretful, and peevish; there may be shivering, vomiting, and headache, together with loss of appetite, whilst the hands feel hot to the touch, and the

face is usually flushed, because the temperature is raised. In very young children, convulsions frequently precede the other symptoms.

These conditions are more or less the same in the commencement of any illness, and any child in which such symptoms appear, should be at once removed from the school.

The *specific symptoms* usually to be observed in the commoner forms of sickness are as follows.

Whooping Cough. In this form of disease the period of latency is about a fortnight. The commencement of the illness then closely resembles a severe cold, accompanied by feverishness, and a troublesome and persistent cough, which may last a fortnight. The cough soon assumes a paroxysmal character beginning with a deep inspiration followed by a rapid succession of short coughs, without the possibility of any inspiration, the patient consequently appears for the moment to be bordering upon suffocation, when a long whistling or whooping inspiration occurs, which gives the name to the illness. This may be repeated at longer or shorter intervals, and upon this the severity of the disease depends. The disease is infectious, and amongst young children most distressing and fatal. Extreme care should be taken to exclude from school all children with the characteristic whoop, and also children coming from infected houses.

Mumps. The latent period of mumps varies between 14 and 21 days. The symptoms characteristic of mumps are pain and tenderness at the back of the lower jaw, followed by swelling there. The aching, tenderness, and swelling increase for two or three days, sometimes on one side, sometimes on both sides, considerably altering the appearance of the face. The swelling remains for about six days and is attended with general symptoms of ill-health: after that time it gradually disappears, and sometimes the skin peels off over the swollen parts. The disease is not a serious one, but is attended by considerable discomfort, and frequently occurs in widespread outbreaks.

Measles. The incubation period of this disease is about 12 days. The characteristic symptoms which measles superadds to those common to infectious sickness are those which accompany a severe cold, discharge from the nose, running from the eyes, hoarseness. On the fourth day inclusive from the commencement, a purplish bluish rash appears, first about the forehead and scalp, then on the face and neck, and gradually extends over the body. It lasts 4 or 5 days, and its disappearance is followed by the skin peeling off in fine particles. The severity of the disease varies greatly but it is excessively fatal to young children, usually on account of bronchitis or inflammation of the lungs, which complicates it.

Scarlet Fever. This disease has a short period of latency, usually 4 days. The illness then is usually sudden, and accompanied by vomiting, sore-throat, quick pulse, feverishness. The rash appears on the second day, first on the chest, and very quickly afterwards on the arms, abdomen and thighs, from which it may spread all over the body. The tongue becomes brightly red, with swollen papillæ, which gives it something the appearance of a strawberry. When the fever abates, and the rash disappears, the skin peels off, usually in flakes, which are especially large in the case of the hands and feet. Convalescence is usually protracted, and infection remains for a considerable time.

Diphtheria. The period of latency of diphtheria is short, averaging about 3 or 4 days. The child becomes dull, pallid, and moping, chills and shivering occur, and the child complains of sore-throat. The throat if examined will be seen to be deep red, somewhat swollen, and after a day or so whitish patches may be seen on it, and it is these which give the name to the disease, from the Greek word "*διφθέρα, diphthera*," *leather.* The disease is excessively infectious and very fatal, and great care is necessary in dealing with it, both in regard to the sick child, as well as to prevent the spread of infection.

It is not necessary to enter into details in regard to the

more formidable diseases of typhus, typhoid, and small-pox, since the constitutional disturbances associated with their commencement would prevent children attending school.

Typhoid Fever, or *Enteric Fever*. The commencement of this disease is usually insidious, with feeling of general lassitude and malaise, aching in the limbs, loss of appetite, signs of disturbance of the stomach and bowels, and tendency to diarrhœa. Chills, shivering and flushes of heat are among the early symptoms. With the progress of the disease these symptoms increasing in severity develop ultimately into the grave characteristics of this form of illness.

It is obviously of great importance to the patient to be quietly isolated at as early a stage as possible; it is equally important in the interests of the other scholars that this should be done, for the infection lies in the dejecta and in anything such as clothing, linen &c., which directly or indirectly may be soiled with them; the latrines used by the sick child may be the means of infecting healthy children. This form of illness, perhaps more than any other, owing to the obscurity of the early symptoms, illustrates the necessity for keeping from school children who are at all out of sorts or suffering from vague and indefinite illness.

Chicken-pox is a very infectious disease characterised by a small blister-like eruption appearing in successive crops, which dry into scabs in the course of two or three days. It is communicable by means of the air, and also by clothing, books &c., which have been infected. The commencement of the illness is usually unattended with symptoms more severe than slight feverishness and general malaise; minute red spots appear within 24 hours and these speedily develop into the vesicular eruption already described which is usually most abundant on the back.

The malady usually lasts ten days or a fortnight, but it often happens that children remain weak and out of sorts for some weeks after an attack.

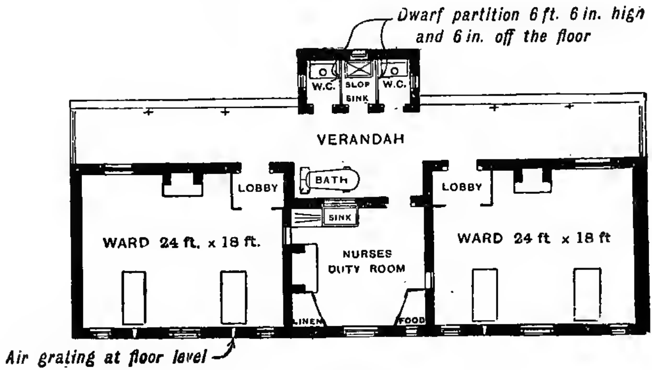
Ringworm. This is a readily communicable disease, parasitic in character, and is caused by a microscopic fungus which after a time insinuates itself into the hair follicles and between the fibres of the hairs, and therefore soon gets beyond the reach of remedies applied only to the surface; hence the need for preventive measures. It may easily be communicated from one child to another by caps, towels, brushes and combs, &c., and the lower animals, cats, dogs, rabbits, &c., may also impart it. Any part of the body is liable to be attacked, but the scalp is the most frequent seat, and here it is most difficult to get rid of, especially in the case of ill-nourished, or strumous children.

The disease usually appears as a small ring of scurfy scales, or minute reddish pimples at the circumference of a slightly raised and scaly spot; these dry up and fine branny scales take their place; the ring rapidly extends and becomes very characteristic in appearance; most of the hairs have broken off and look like stubble. Itching is one of the earliest symptoms. It is important that the disease should be discovered as early as possible, because the longer treatment is delayed the more intractable does it become. In suspected cases the head should be carefully examined in a good light, beginning at the bottom of the back part of the head and turning the hairs up the wrong way so as to expose the scalp little by little.

Isolation Ward.

With regard to the practical means of isolating infected children, this matter, so far as board schools and all other day schools are concerned, is dealt with by the Sanitary Authority, who makes provision for such cases. In the case of boarding schools, however, the circumstances frequently are different. If the school is situated in or near a town where an isolation hospital is provided, no better course can

be pursued than having the patient removed to such an institution. In these days there are few, if any, towns without a hospital of the kind, but when the school is situated in the country it may be necessary to provide a small isolation hospital. Most purposes will be served by a one storey building, such as shown on the plan, divided into two wards with one or perhaps two beds in each. Into one or other of these, doubtful or suspicious cases of illness can be isolated for observation, or they can remain to be treated throughout the whole of the illness. Its construction, drainage, water-supply, ventilation and lighting will be carried out upon the ordinary principles. The building itself should be placed in such a position that it shall be effectually cut off from the rest of the school buildings and grounds, and it will be required to be so administered that the persons in charge shall have no direct contact with other inmates of the school. The plan is one suggested by the Local Government Board as a suitable ward block or unit for a small community.



PLAN

CHAPTER VII.

ACCIDENTS AND EMERGENCIES.

It is never desirable that a teacher should accept the responsibility of treating illness or injuries, but as medical assistance is not always at hand either in the playgrounds or the schoolroom to meet every emergency it is clearly of advantage that he should know what to do pending the arrival of the doctor. It cannot be too strongly emphasised as a first principle, that every injury needs rest for its repair; indeed the common symptom of pain when an injured part is moved or touched is merely a reminder to keep it quiet.

Bruises and *contusions* should be immediately treated by the local application of cold; a handkerchief wetted, and kept wet with cold water, or the application of an ice bag, or an evaporating spirit lotion, or a lotion of acetate of lead, will lessen the swelling and minimise the subsequent discoloration. In every case, the more promptly the cold is applied the better. The appearance of a bruise, as for example a "black eye," is due to the fact that minute capillary blood-vessels in or beneath the skin have been ruptured, and that some blood has escaped into the tissues; this blood gives rise during its absorption and disappearance, to the rainbow-

like hues of the discoloration, and the object of the cold dressing is to limit the actual escape of blood. In injuries involving abrasion or breach of the surface of the skin, the injured part should be carefully washed free from dirt, and a dressing of wet lint applied.

Severe injuries sometimes arise from laceration, skin and subcutaneous tissue being torn, but the amount of bleeding in these cases is usually slight, and is no index to the seriousness of the wound.

Clean cuts should have the edges brought carefully together, and a piece of clean dry lint placed upon them and kept in position by a carefully adjusted bandage. A piece of sticking-plaster will do excellently for small cuts; the edges of the plaster should be nicked before it is applied. Bleeding from cuts or punctured wounds may be easily arrested by pressure; a pad may be made of a folded piece of lint or firmly folded handkerchief and pressed firmly over the wound.

Hæmorrhage (bleeding) results from division or rupture of a blood-vessel, either an artery, a vein, or capillary vessel; arterial bleeding—resulting *e.g.* from the severance of a small artery by a fall on the head—is distinguished from venous or capillary by the bright colour and freer flow, which comes in spurts corresponding to the heart-beats. Each form, either the arterial jets, or the continuous venous flow, can always be temporarily and usually permanently stopped by pressure upon the wound in the manner indicated, but if the hæmorrhage is at all copious the pressure must be firmly persevered with till the doctor comes. The slighter forms are often arrested by cold alone.

Nose bleeding occurring by itself is seldom of serious importance in children in good health. In order to check it regard must be had to position; the patient's head should never be bent down over a basin; he should sit down, with the head thrown back, with a towel spread in front like a bib

to prevent the clothes, previously loosened, from being soiled, and he should avoid frequently blowing and wiping the nose. Cold may be applied to the nose and to the nape of the neck.

Bites of animals cause irregular wounds, jagged and contused, which are often difficult to heal. Wet lint, or a wet handkerchief or other fomentations may be applicd to relieve pain. If there is excessive bleeding it must be arrested in the manner indicated, but some bleeding may be advantageous.

Stings of insects are often exceedingly painful; a poultice will relieve this. Usually oil or glycerine or sal volatile may be applied with advantage.

Foreign bodies in the eye or ear may sometimes be lifted out; a probe should never be used except by the skilled person, and if difficulty is met, the doctor had better be referred to.

Fractured limbs. Fractures are not usually difficult to detect. Apart from the pain on attempting movement, there is usually more or less bending or twisting of the injured limb; this deformity arises from the displacement of the bone, and is also caused by the weight of the parts previously supported by the bone.

The aim in treatment is to keep the parts at rest, as nearly in the natural position as possible, and to prevent further displacement, above all to prevent the ends of the broken bone being thrust through the skin. If the leg is broken the patient should be carried home with the greatest care. The sleeve or trouser should be cut up and not pulled off.

Splints are used to support the limb and prevent displacement. They must be so applied that there shall be no pressure at the seat of injury, and in all cases must be carefully padded. They are usually of wood but temporarily other contrivances may be used so as to keep the parts immovable, *e.g.* pasteboard, thatch, or bundles of unbroken straw; umbrellas have served the purpose.

Slings and bandages may be usefully made with handkerchiefs and pinned where necessary; the accompanying figures explain the way in which handkerchiefs may be applied.

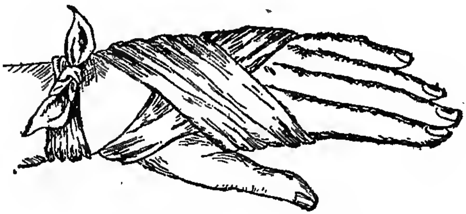


Figure-of-eight for the hand.

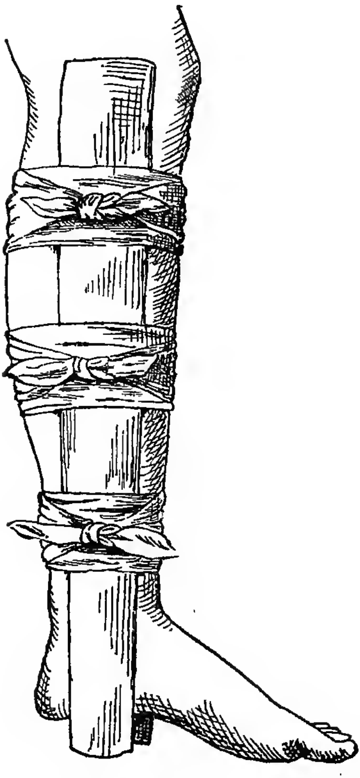
Fig. 9.

Handkerchief dressing for the foot.

Fig. 10.

Handkerchief dressings for the shoulder, hand and elbow; and small sling.

Fig. 11.



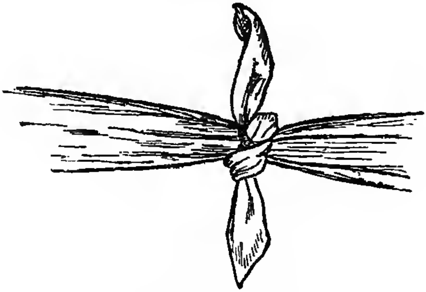
Provisional splints for fracture of the leg.

Fig. 12.

Care must be taken that a reef knot, and not a "granny" knot is tied.

Square-knot.

Fig. 13.



Granny-knot.

Fig. 14.

In very young children the bone is sometimes bent, and does not actually fracture, giving rise to a condition known as a "green-stick fracture."

Sprains result from a sudden wrench or twist by which the capsule or ligaments of a joint, or certain sheathing structures in its neighbourhood are stretched or torn. Pain, swelling and inflammation result, and the first aid consists in applying cold and in ensuring absolute rest for the injured part.

Burns and scalds should be treated with oil; there is no better application than a piece of lint well soaked in a mixture of equal parts of olive oil and lime-water; a little cotton-wool should be placed over this and kept in position by a light bandage.

Fits of various kinds may occur in school.

Fainting may occur in close and ill-ventilated rooms. The patient should at once be removed into the open air, or windows and doors should be thrown open, he should be placed on his back with the head low, his clothing should be loosened, and persons should not be allowed to crowd round him. Cold water may be sprinkled on his face and neck and chest, but no attempt should be made to make him drink whilst he is unconscious, or he may choke.

Epilepsy is characterised by the patient becoming unconscious, usually with short or no warning. He falls with a cry, and the fall may injure him, he remains unconscious, often frothing at the mouth, and frequently bites his tongue. Squint and distortion of the face are common. He should be so placed that he may not injure himself, and a piece of cork placed between the teeth to prevent him biting the tongue. The fit is usually followed by prolonged sleep. The seizures vary widely in severity in different cases, and are apt to recur. The epileptic must be regarded as an invalid.

Hysteria is more frequent in girls than boys; the fits are preceded or accompanied by emotional excitement, weeping or laughter, cries and screams; the patient falls on to the sofa, or gently and without injury to the floor, where convulsive movements more or less extensive are continued. The patient should be removed from the school.

Care of the Teeth. Observations of recent years have very conclusively shown that imperfect dental efficiency is frequently responsible for general derangement of health.

Most of the damage is done in childhood, especially between the ages of 7 and 14 years, and a great opportunity for doing good rests with those who have the supervision of children at these ages.

The fact that dental surgeons have been appointed not only to the great public schools, but to many public elementary schools, indicates the importance attached to the care of the teeth.

APPENDIX I.

THE BOARD OF EDUCATION. BUILDING RULES.

1. Planning and Accommodation.

1. In planning a school, the first thing is to seat the children in the best manner for being taught. The accommodation of each room depends not merely on its area, but also on its shape (especially in relation to the kind of desk proposed), the positions of the doors and fireplaces, and its proper lighting. The second point is to group the rooms together in a compact and convenient manner.

2 & 3. Schoolrooms.

2. Every school must have a schoolroom as hereunder or a Central Hall as under Rule 8. The proper width for a schoolroom is from 18 to 22 feet. In a room 18 feet wide groups of long desks, three deep, should be used; where four rows are used the width should be 21 feet 6 inches, and if the width is 22 feet, dual desks, five rows deep, are most suitable. (For class-rooms, see Rule 7.)

(*a*) Accommodation in schoolrooms for elder children is calculated by the number of children seated at desks and benches, subject to a minimum of 10 square feet per child being provided. For the mode of calculating accommodation in class-rooms see Rule 7, in infant schools see Rule 16 (*f*).

(*b*) Double bank schools (now almost obsolete) require rooms 32 feet wide, walls left clear for three rows of desks, and ample lighting from windows on both sides extending to ceiling.

(*c*) Wasted space cannot be considered.

3. The doors and fireplaces should be arranged so as to allow the whole of one side of any school or class-room to be left free for the groups of benches and desks.

(*a*) No schoolroom lighted from one side only can be approved. The gable ends should be fully utilised for windows. (See also Rules 9 and 9 (*b*).)

4. Walls, Floors, and Roofs.

4. The walls of every room used for teaching, *if ceiled at the level of the wall-plate*, must be at least 12 feet high from the level of the floor to the ceiling; and, if the area contain more than 360 superficial square feet, 13 feet, and, if more than 600, then 14 feet.

(*a*) The walls of every room used for teaching, *if ceiled to the rafters and collar beam*, must be at least 11 feet high from the floor to the wall-plate, and at least 14 feet to the ceiling across the collar beam.

(*b*) Great care should be taken to render the roofs impervious to cold and heat.

(*c*) Roofs open to the apex are not approved. They can only be permitted where the roofs are specially impervious to heat and cold, and where apex-ventilation is provided. Iron tie-rods are least unsightly when placed horizontally.

(*d*) The whole of the external walls of the school and residence must be solid. *If of brick*, the thickness must be at least one brick and a half; and *if of stone*, at least 20 inches.

(*e*) All walls, not excepting fence walls, should have a damp-proof course just above the ground line.

(*f*) The vegetable soil within the area of the building should be removed, the whole space covered by a layer of concrete not less than 6 inches thick, and air bricks inserted in *opposite* walls to ensure a through current of air under floors for ventilation to joists.

(*g*) Timber should be protected from mortar and cement by asphalte or tar.

5. Entrances.

5. Entrances should be separate for each department. In large schools more than one entrance to each department is desirable. (See also Rule 10.) The principal entrances should never be through the cloak-room. Entrance doors and the doors

of main rooms should open outwards as well as inwards. A porch should be external to the schoolroom. An external door having outside steps requires a landing between the door and the steps.

6. Cloak-rooms and Lavatories.

6. Cloak-rooms should not be passages and should be external to the schoolrooms and class-rooms, with gangways at least 4 feet wide between the hanging-rails, and amply lighted from *the end.* They should not be placed against a gable wall. (See Rule 3 (*a*).) The hanging-rail should be arranged so that the children can enter and leave the cloak-room without confusion or crowding. Hat-pegs should be 12 inches apart, numbered, and of two tiers. The lineal hanging-space necessary to provide a separate peg for each child is thus 6 inches.

Thorough ventilation is essential, so that smells are not carried into the school.

Lavatory basins are needed. (*See Rule* 13 (*h*).) Girls' schools require a larger number than boys' or infants'.

A lock-up slop sink, water tap, and cupboard are desirable for the caretaker.

7. Class-rooms.

7. Class-rooms are calculated at 10 square feet if not providing accommodation for more than 60 children. Six rows of dual desks or five rows of long-length desks are permissible in such class-rooms. Rule 2 applies to all rooms providing accommodation for more than 60, or being more than 24 feet 8 inches deep from the window wall.

In all class-rooms the children's desks should be so arranged that the teacher's desk shall be not more than 20 feet from the centre of the back row, and that that row shall not subtend an angle greater than 60° at the teacher's desk.

(*a*) The minimum size of class-room is 18 feet × 15 feet. If desks are placed longitudinally the width should not be less than 16 feet. This latter width is also allowed in schoolrooms of very small size.

(*b*) The class-rooms should never be passage-rooms from one part of the building to another nor from the schoolrooms to the

playground or yard, and should be on the same level as the schoolroom. Each should be easily cleared without disturbance to any other room. Doors should open both ways.

(*c*) The number of class-rooms should be sufficient for the size and circumstances of the school.

(*d*) The excessive use of movable partitions should be avoided.

8. Halls.

8. Large schools are sometimes planned with a Central Hall, from which the class-rooms are entered. The Hall must be fully lighted, warmed, and ventilated, and must contain a floor space of not less than 1,200 square feet. Halls of excessive size are not approved.

If desired, one class (or under special circumstances two classes) will be allowed in the Central Hall, provided the Hall is suitably planned for teaching such class or classes. The position of such class or classes should be shown on the plan.

9. Windows.

9. Every part and corner of a school should be fully lighted. The light should, as far as possible, *and especially in class-rooms*, be admitted from the left side of the scholars. [This rule will be found greatly to influence the planning. (*See Rules* 3 (*a*), 9 (*b*), *and* 11 (*a*).)] All other windows in class-rooms should be regarded as supplementary, or for summer ventilation. Where left light is impossible, right light is next best. Windows full in the eyes of teachers or scholars are not approved. In rooms 14 feet high any space beyond 24 feet from the window wall is insufficiently lighted.

(*a*) Windows should never be provided for the sake merely of external effect. All kinds of glazing which diminish the light and are troublesome to keep clean and in repair should be avoided. A large portion of each window should be made to open for ventilation and for cleaning.

(*b*) The sills of the main lighting windows should be placed about 4 feet above the floor. And the tops of some should reach nearly to the ceiling with a portion made to swing. The ordinary rules respecting hospitals should here be remembered. *Large*

spaces between the window heads and the ceiling are productive of foul rooms.

(*c*) Skylights are objectionable and should never be resorted to where windows are possible. Plans needlessly involving their use cannot be approved except in the case of central halls having ridge, or apex ventilation.

10. Staircases.

10. A staircase should be fire-proof and external to the school-room. No triangular steps or "winders" should be used. Each step should be about 13 inches broad, and not more than 5½ to 6 inches high. The flights should be short, and the landings unbroken by steps. The number of staircases should be sufficient, not only for daily use, but also for rapid exit in case of fire or panic.

11. Ventilation.

11. Apart from open windows and doors, there should be provision for copious inlet of fresh air; also for outlet of foul air at the highest point of the room; the best way of providing the latter is to build to each room a separate air chimney carried up in the same stack with smoke flues. An outlet should have motive power by heat or exhaust, otherwise it will frequently act as a cold inlet. The principal point in all ventilation is to prevent stagnant air. Particular expedients are only subsidiary to this main direction. Inlets are best placed in corners of rooms furthest from doors and fireplaces, and should be arranged to discharge upwards into the rooms. Inlets should provide a minimum of 2½ square inches per child, and outlets a minimum of 2 inches. All inlets and outlets should be in communication with the external air. Rooms should, in addition, be flushed with fresh air from windows about every two hours.

A sunny aspect is especially valuable for children, and important in its effects on ventilation and health.

(*a*) Although lighting from the left hand is considered so important, ventilation in summer demands also the provision of a small swing window as far from the lighting as possible, and near the ceiling.

12. WARMING.

12. The warming should be moderate and evenly distributed so as to maintain a temperature of from 56° to 60°. When a corridor or lobby is warmed, the rooms are more easily dealt with, and are less liable to cold draughts. Where schools are wholly warmed by hot water, the principle of direct radiation is recommended. In such cases open grates in addition are useful for extra warming occasionally, and their flues for ventilation always.

(*a*) A common stove, with a pipe through the wall or roof, can under no circumstances be allowed. Stoves are only approved, when

- (i) provided with proper chimneys (as in the case of open fires);
- (ii) of such a pattern that they cannot become red-hot, or otherwise contaminate the air;
- (iii) supplied with fresh air, direct from the outside, by a flue of not less than 72 inches superficial; and
- (iv) not of such a size or shape as to interfere with the floor space necessary for teaching purposes.

(*b*) A thermometer should always be kept hung up in a school.

13. SANITARY ARRANGEMENTS.

13. Water-closets within the main school building are not desirable, and are only required for women teachers. All others should be at a short distance and completely disconnected from the school. Privies should be fully 20 feet distant.

(*a*) The doors, staircases, and passages leading from the schoolroom to the latrines (whether in mixed or in other schools) and the latrines themselves, must be separate for the two sexes, and constructed entirely apart from each other. In the case of a mixed school this rule especially affects the planning. Where passages or corridors are *unavoidably* used by both sexes, there must be complete supervision from the class-rooms by sheets of clear glass.

(*b*) Each closet must be not less in the clear than 2 feet 3 inches wide nor more than 3 feet, *fully lighted and ventilated* and properly screened or supplied with a door. More than one seat is not allowed in any closet.

(*c*) The children must not be obliged to pass in front of the teacher's residence in order to reach their latrines.

(*d*) The following table shows approximately the number of closets needed:

——	For Girls	For Boys	For Infants
Under 30 children	2	1	2
„ 50 „	3	2	3
„ 70 „	4	2	3
„ 100 „	5	3	4
„ 150 „	6	3	5
„ 200 „	7	4	6
„ 300 „	8	5	7
		Urinals in proportion	

(*e*) Cesspits and privies should only be used where unavoidable, and should be at a distance of at least 20 feet from the school. [Building Form "A," which may be obtained on application, gives suggestions as to their construction and arrangement.] Earth or ash closets of an approved type may be employed in rural districts, but drains for the disposal of slop and surface water are still necessary. The proximity of drinking-wells should be carefully avoided.

(*f*) Soil-drains must always be laid outside the building (on a hard even bottom or concrete) in straight lines with glazed stoneware pipes, carefully jointed in cement and made absolutely water-tight. A diameter of 4 inches is sufficient unless for drains receiving the discharge of more than 10 closets. Above this number the diameter should be 6 inches. The fall should never be less than 1 in 30 for 4-inch, and 1 in 40 for 6-inch drains. An inspection opening or chamber should be provided at each change of direction so as to facilitate cleansing the drain without opening the ground. Every soil-drain must be disconnected from the main sewer by a properly constructed trap placed on the line of drain between the latrines and the public sewer. This trap must be thoroughly ventilated by at least two untrapped openings; one being the 4-inch soil pipe carried up full size above the roof, and the other an inlet pipe connected with the side of the trap furthest from the public sewer. Automatic flushing tanks are desirable where trough closets are used.

(*g*) Urinals must in all cases have a sufficient supply of water for flushing.

(*h*) Waste pipes from sinks or lavatories should be first trapped inside and then made to discharge direct through an outer wall over a trapped gulley.

14. Sites and Playgrounds.

14. Every school should have an open airy playground proportioned to the size and needs of the school, and the site should, if possible, have a building frontage in proportion to its area. The minimum size of site is, in the absence of exceptional circumstances, a quarter of an acre for every 250 children. If the school is of more than one story this area may be proportionally reduced; but the minimum unbuilt on or open space of 30 square feet per child should be preserved.

(*a*) In the case of a mixed school of large size, playgrounds should be separate for the boys and girls.

(*b*) All playgrounds should be fairly square, properly levelled, drained, inclosed, and fitted with some simple appliances. A portion should be covered, having one side against a boundary wall. A covered-way should never connect the offices with the main building. Buttresses, corners, and recesses should be avoided.

(*c*) An infant school should have its playground on the same level as the school and open to the sunshine.

APPENDIX II.

LONDON SCHOOL BOARD AND INFECTION IN SCHOOLS.

Clause 4, Sec. 55 of the Public Health (London) Act, 1891, is designed to ensure that the head teachers of schools shall receive prompt information of the existence of notifiable infectious sickness at the homes of pupils. It enacts that:—

Where a medical officer of health receives a certificate under this section relating to a patient within the Metropolitan Asylum district, he shall, within twelve hours after such receipt, send a copy thereof to the Metropolitan Asylums Managers, and to the head teacher of the school attended by the patient (if a child), or by any child who is an inmate of the same house as the patient.

The following are among the valuable regulations and instructions issued by the London School Board, for the guidance of teachers and their staff:—

(i) In order to maintain the sanitary condition of the schools, the Head Teacher of each department is held responsible for seeing that the following regulations are carried out:—

(*a*) The whole premises are to be properly ventilated, both during school hours and after the children have left.

(*b*) The rooms are to be washed at least once every three weeks except where otherwise ordered by the Works Committee.

(*c*) Children who may present themselves in a dirty condition are to be required to wash at once; and, if further purification is needed, to be sent home for the purpose.

(*d*) Each child in the school is to be provided with a peg, on which must be hung its cap, bonnet, cloak, or shawl.

(*e*) Any bad smells arising from defective drainage are to be reported at once to the Head Office.

(*f*) The urinals and drains must be sluiced out twice a day, viz., in the middle of the day and after school in the evening.

(*g*) Schoolkeepers are not supplied with disinfectants, as the Works Commitee are of opinion that if the troughs, urinals, and W.C.'s are systematically and thoroughly flushed in accordance with the Code of Instructions for the guidance of Schoolkeepers, the use of disinfectants will be unnecessary. In the event of it becoming necessary to disinfect a school or Schoolkeeper's house, the local authorities must be requested to carry out the work.

(ii) Any child showing symptoms of an infectious disease, or any child coming from a house[1] where an infectious disease exists, must be sent home *at once*, and the Superintendent of Visitors must be immediately informed of the case, care being taken to state the name of the child or family infected in order that enquiries may at once be made with a view to proper steps being taken to prevent the children living in the same house or tenement from attending School. The Medical Officer of Health for the District must also at the same time be informed of the child's exclusion, and furnished with the name and address of the child and the reason for its exclusion on a form with which the teachers will be supplied by the Head Office.

Whenever Teachers communicate with the Medical Officer of Health for the district, relative to an outbreak of infectious disease in the schools, they must at the same time communicate with the Medical Officer of the Board.

[1] Children coming from houses in which erysipelas exists, but who are not themselves suffering from the disease, are not to be excluded from the school.

(iii) Under the provisions of the Public Health (London) Act, 1891, the Medical Officer of Health must, whenever a case of infection shall, in the first instance, come under his notice, forward direct to the Head Teacher of the School attended by a scholar suffering from an infectious disease, or attended by any child who is an inmate of the same house as the patient, a certificate notifying the fact, care being taken to state the name of the child or family infected.

The notification Certificate of the Medical Officer of Health will be received by the Head Teacher, who must at once see that the communication is sent to the other Head Teacher, or Head Teachers, of the other department, or departments, of the school concerned.

When the teacher has received this notification from the Medical Officer of Health, and taken all necessary action, he should note upon the certificate the action taken, endorse it with his name and the name of the school, and also state upon it whether the patient is a scholar of the school, and, if so, the department of the school which the patient attended before illness, and forward it immediately to the Head Office, addressed "The Medical Officer, School Board for London, Victoria Embankment, W.C." The teacher should likewise send notice of the case to the Superintendent of Visitors, if that has not already been done, on a form to be supplied for the purpose from the Head Office.

The words, "Infectious Disease," mentioned in the first paragraph of this section mean any of the following diseases, namely: small-pox, cholera, diphtheria, membranous croup, erysipelas, the disease known as scarlatina or scarlet fever, and the fevers known by any of the following names: typhus, typhoid, enteric, and relapsing.

There are, however, other diseases which are "infectious," such as mumps, measles, chicken pox, whooping cough, and ringworm, for which the Medical Officer of Health is not required by the Public Health (London) Act, 1891, to furnish a notification certificate.

(iv) Children excluded because of infectious disease or because of infectious disease in their homes as defined in the 4th paragraph

of section (iii) must not be allowed to return to school unless a certificate has been received from the Medical Officer of Health, stating that the premises are free from infection. Head Teachers will note that the certificate forwarded by the Medical Officer of Health merely states that the premises from which the children come are free from infection, and does not certify that the children are in a condition to be permitted to resume attendance at school, for it may be that, though the premises are free from infection, the children coming from such premises may be sickening for an infectious disease. It will be necessary, therefore, for a further period of seven days to elapse, before the return of such children to school, unless the Medical Officer of Health shall specially certify that a longer period of absence is necessary.

In the event of the Head Teacher not receiving the certificate stating that the premises are free from infection, it becomes his duty to send to the offices of the Local Authority in order that he may procure it.

(v) Children suffering from mumps or measles must be excluded for at least one month. Children coming from a house in which mumps exists should be excluded from school for such time as the Medical Attendant in each case deems necessary. In cases where there has been no Medical Attendant, children should be excluded from school for three weeks.

Children suffering from chicken pox must be excluded for at least two weeks.

Children suffering from whooping cough must be excluded as long as the cough continues.

Children coming from houses where measles, chicken pox, and whooping cough, exist, but who are not themselves suffering from these diseases, must be excluded from school for fourteen days.

Any child suffering from ringworm or ophthalmia should be excluded from school, and, before it is re-admitted, a medical certificate should be produced stating that the child is cured; but whenever such a certificate is not readily procurable, the teacher should exercise his, or her, discretion in re-admitting the child.

(vi) Symptoms of Infectious Diseases.—Most of these maladies are attended by the appearance of a rash upon the skin, but this

eruption does not at once show itself. The child may ail for a day or two first and the rash not make its appearance until later. But even before the rash shows itself, there are usually certain symptoms present, which should give rise to suspicion on the part of the teacher, and these indicate the need for watchfulness over the child.

Thus, a child sickening for an infectious disease usually complains, perhaps, of headache, or perhaps of sore-throat, and often the first symptom perceptible is a shivering fit and occasionally sickness.

PART II.

THE CHILD.

CHAPTER VIII.

INTRODUCTORY—GENERAL CONSIDERATIONS.

WHEN a child passes from its home to the school it is brought under a new set of influcnces, and the rcsponsibilities of the parent are transferred to the teacher. In the case of boarding-schools the teacher obviously directs and colours the whole life of his pupil so far as one human being can modify the development of another by means of surroundings and customs, precept and example.—In the matter of mental training nothing less is demanded, else why send the child to school? The lifelong influence exercised by successful headmasters over the minds and conduct of their pupils is universally admitted and admired, but it is not so generally conceded that a man's physical health may in like manner be largely dependent on the wise or ignorant regulation of his school-life. For nine months in the year, during the pcriod of formation, when mind and body are most impressionable, the parent fades into the background, the teacher becomes all important, and on him rests the grave responsibility of preparing a fellow-creature for the struggle of life.

In the case of day schools the transference of authority is less obvious but practically scarcely less complete. The responsibility may seem to be shared between the parent and teacher but in reality the parent has very little say in the

management of the daily life. The child is directly under the control of the teacher the greater part of the day (perhaps from 9 a.m. to 4 p.m.), but the school influence extends into the home. Meal times are regulated, not by the wants of the household, but by the school, so also is the time allowed for freedom in the open air, and bed-time depends less on sleepiness than the time needed for the preparation of home lessons. Who is not familiar with the spectacle of the "revival of learning" on the part of parents assisting with grammar and dictionary in order to abridge the labour of translation and pack their offspring off to bed in reasonable time? Having chosen a school the parent must abide by his choice. His individuality is swamped by the crowd of other parents, his demands are neutralized by counter demands or by the requirements of school organization. If the head-teacher be not weakly pliant (and no worse disqualification could be named) he becomes scarcely less autocratic (so far as the question of health is concerned) than the head of a great public school. We may take it the responsibility of every teacher is grave, personal, and cannot be shirked. A frank acceptation is the only practical policy.

The paramount duty of the teacher towards health is to promote it. Current public opinion tends to exonerate him who does no harm, but with a national system of education, adopted as an inalienable duty of the State, this narrow and pernicious view is doomed to speedy effacement. The primitive notion that the mind is something independent of the body is rapidly being discredited and replaced by the view that the brain is the organ of thought, and therefore a healthy brain is the first necessity for a successful career. Public opinion in the immediate future is likely to ask the schoolmaster for strong healthy brains rather than for a superficial acquaintance with specific subjects that scarcely outlive the date of an examination.

It is to be hoped that in the immediate future Government

grants will be awarded partly on the condition of the physical health of the children. Payment by results would then be an unmixed benefit.

The teacher called upon to study and apply the laws of health may at the onset be discouraged by the difficulties to be encountered. But he need not be alarmed. The laws of health are very like the laws of the land, exceedingly easy to obey, though prodigiously difficult to investigate and master in detail. Most citizens contrive to pass their lives without committing legal offences without any knowledge of the law but simply by the exercise of common-sense; though judges of great erudition and experience are scarcely able to decide on questions that continually arise. So common-sense will carry a teacher over the difficulties without any particular acquaintance with the intricate details of public health or the intimate physiology of the vital organs. Thus the essentials of a healthy life have been known, from such time as the memory of man runneth not to the contrary, to be wholesome food, pure air and water, exercise, and sufficient rest to compensate for fatigue. Science adds very little, but is able to determine by analysis and the microscope the impurities that may exist in food, air, and water, and to shew why fatigue is prejudicial. We are all convinced of the value of fresh air, and we know it is to be found on a hill side or the deck of a ship, but not in a school-room, even the best arranged. Science confirms our empirical experience and explains to us that the atmosphere of the mountain and the sea is comparatively pure, but that the air in the school-room is laden with carbonic acid, bodily emanations, microbes from the nose, lungs, or the skin, ready to pass from one child to another and set up disease. But every one who has watched growing children knows that they do not flourish as they should if kept long in school, but if brought up mostly in the open air they do. Science does not tell us the fact, merely tells us the reason why. We need not wait for Science to do right.

The teacher then has only to regard his charges as young animals requiring to be trained, and to place before himself a sufficiently high standard of physical perfection. He must study the signs of health, he must study the signs of failure, not from books or hearsay, but from the living subject. He must study the senses and their organs in relation to school-work, especially noting where injury is most easily inflicted, as for example in the case of the eye and excessive book-work, or in the case of the nose and throat and the rebreathing of polluted air. He must study the differences between the child, the adolescent, and the adult. He must study the peculiarities of the growth and development of individual children and be prepared to vary his routine to suit the necessities of each case. He must remember that health and strength are but slowly built up, that the influences that tell against even a fairly good development in modern town life are very numerous and very powerful and difficult to withstand. Artificial ills require artificial antidotes. For instance, natural life in the country affords sufficient open air exercise, but the shut up, indoor life led by the middle classes in towns can only be effectually counteracted by the systematic exercise taken of set purpose. The country schoolmaster may afford to neglect what the town schoolmaster must supervise with unremitting attention.

Part of the purpose of the following pages is to shew that it is the teacher's duty to take an active and not merely a passive part in relation to health and physical development. To impress upon all guardians of the young that though health is an affair of many circumstances (*e.g.* ancestry) that may be beyond our personal control, it is within the power of any one of moderate intelligence to understand the grounds upon which modern hygiene is founded and to shape the conduct of the school (or the nursery) accordingly. Observation, sympathy and common-sense are the most needed qualities, but they must be accompanied by an intellectual freedom sufficiently vigorous

to withstand authority tradition and prejudice. Every school-custom, the time-table, the lessons, should be examined and tested at first-hand in relation to health. Nothing should be taken for granted or because it appeared to do well in the past, or because it suits another school or another set of circumstances. It is your own town and its particular degree of smokiness or airiness, the feeble or healthy class of the parents, your own street, your own school and your own scholars that are to be considered and nobody else. Health starts from the home and should be improved in school because the teacher ought to possess more profound convictions and more experience than most parents.

THE DOCTOR should be the adviser and supporter of the schoolmaster. The relations of the teacher to the medical man are generally allowed to begin with the appearance of sickness or accident. This is wrong. The prevention of disease, the avoidance of the causes of predisposition and the right conduct of health are now considered the noblest province in the great arena of medical science. It is better never to be ill than to require to be cured, and schools might advantageously take example from the Chinese, who are willing to pay for health but who refuse to pay for being rid of disease.

At present the relationship of the doctor to the school varies greatly in its intimacy. In some of the great schools the medical officer holds a definite position and visits regularly whether wanted or not. He is allowed some voice in the management, though seldom as much as might be desirable. The close association of Dr Clement Dukes with Rugby has been very advantageous to that great school and his experience has added considerably to our knowledge of the public school boy. Other public schools and private adventure schools for the wealthier classes have benefited by the results of his work, and other schools have found it expedient to have medical men in similar close relationship. But among poorer schools and

especially in girls' schools, where health is often entirely neglected, such an arrangement is rare. But every school should be provided with a doctor who should periodically examine and advise on all the conditions pertaining to health. Where a medical supervision does not exist it should be instituted if within the power of the teacher.

The doctor in the second degree of relationship holds a regular appointment to the school but only appears when summoned. That he should see every accident and every suspected case of illness goes without saying. He acts as guide on questions of isolation and quarantine. When there is a determination on the part of teacher and medical man to work together even this degree of relationship may be made very serviceable.

In the day-school the teacher has for the most part to fall back upon the family medical attendant. He can only notify the parents that the child needs a doctor and receive from them a certificate that the child is fit to return to school. Useful hints on the questions of time-table, compulsory games and the existence of organic disease or hereditary proclivities may often be obtained by private communication. But the relationship, though satisfactory for the individual patient is not sufficiently close to be useful to the whole school.

Finally, in general questions concerning buildings, sanitary arrangements, epidemics, and so forth, the teacher may have recourse to the medical officer of health for his district, and a demand for such assistance should never be neglected, for it will never be refused. In brief, the duty of the teacher in regard to the doctor is to provide himself to the best of his ability with an adviser on all questions of physical health, and to throw the whole responsibility of illness on to the medical man. Having done so, if he remain in charge of the child, he should obey orders with the precision and promptness of a soldier.

CHAPTER IX.

THE CARE OF THE EYE.

THE eye is an optical instrument of great complexity and extreme delicacy of structure. It is therefore, like all complicated mechanism, peculiarly liable to injury or disarrangement from slight causes. No other organ of the body is so easily injured by inappropriate or excessive work and no organ has less power of readjustment. By an irony of circumstance no other organ of the body is habitually subjected to such excessive strain in proportion to its power of resistance or put to work for which it is so ill-adapted or treated with so little regard to the perfection of its function, none suffers so severely from the strain of modern education. And yet it would seem reasonable that the organ of the master-sense should be sedulously cared for, and that part of the aim of education should be to render it strong and healthy and fitted to withstand the strain that may be thrown upon it in after-school life. Under a rational system of teaching vision should improve and not deteriorate. A child should leave school with a greater power of seeing than when he entered, and with immensely greater power of interpreting and estimating what he sees. To demand so much would be in the present state of affairs considered beyond the reach of practical effort by the most daring of reformers, though we may perhaps be permitted to consider that something of the sort may not be wholly a dream of an impossible ideal. Now, all we dare ask

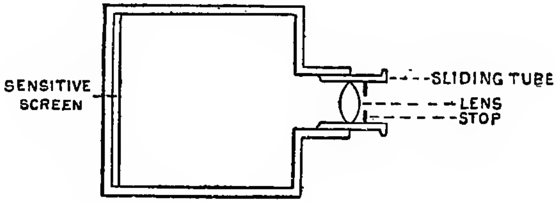
is that actual injury should not be inflicted on children's eyes during the period of school-life. Even this modest request will necessitate considerable reforms in routine teaching and great alteration in the ideas and requirements of ambitious parents. For it must be remembered that teacher and parent play into one another's hands in the policy of asking for small profits and quick returns—in asking for results that can be estimated in the immediate present—the place in class, the passing of examinations, the running of children for advertisement, or for mere vanity and show—which with the concomitant hurry, fuss and cram are responsible for many of the ills suffered by school-children. To begin with we must respect the eye at least as much as we should an expensive instrument purchased from an optician. We must set out with the deliberate intention of taking care of it. To that end we must needs understand something—not much—of its structure and its capacity for work.

The Mechanism of Eyesight.

The organ of vision consists essentially of two parts. One—the eyeball—employed in the refraction of light so that its vibrations may become appreciable by the nervous system and used by "the mind": the other situate within the skull, a most complicated structure forming a considerable part of the back of the brain and having intimate connection not only with the eye, but with other centres governing the senses and the limbs. It is for this the eye exists. It supplies information of the outer world and it is on the integrity of its structure that the brain depends for the correctness of its visual impressions. A faulty or imperfect eye gives faulty or erroneous information and deprives its possessor of an amount of knowledge commensurate with the amount of its defect. Persons with bad sight (from whatever cause) have often most erroneous notions of common objects, trees, mountains, cathedrals and

haystacks appearing much the same, and they not unfrequently make mistakes that lead to trouble in ordinary life. An accurate eye is part of the stock in trade of a well-informed brain. It is therefore one of the first duties of a teacher to see that the eye is sound and not to allow slight defects to increase and become troublesome. A little knowledge of principles aided by common-sense is all that is needed to attain this desirable end.

In principle *the eye is an optical instrument like the photographic camera* now in everybody's hands. If you understand one you understand the other. A quarter of an hour may be well spent in taking a camera to pieces and examining its parts.



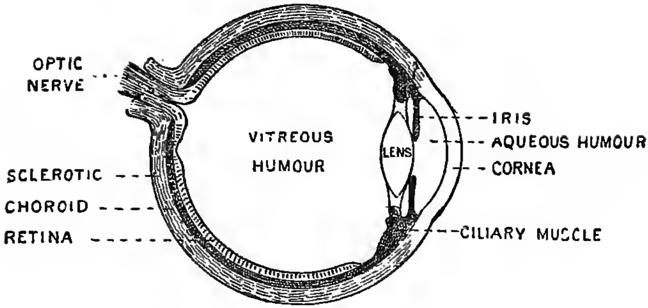
Camera reduced to its simplest expression.

Fig. 15.

It consists of a box, painted black inside to prevent cross-reflexions, and having fitted into one side a lens capable of being adjusted so as to focus rays of light on to a sensitive screen at the back of the box.

The lens can be slid to and fro so as to focus different objects according as they may be situated near to or at a distance. The screen, a thin film soaked in a salt of silver which remains stable in the dark but which changes to a darker and darker brown according as it is exposed to a duller or brighter light. So the ordinary photographs are taken.

THE HUMAN CAMERA.



Horizontal Section of the Human Camera.

Fig. 16.

The eye is a globular chamber with its walls composed of tough fibrous tissue of the nature of gristle. A portion of this [the sclerotic] is visible between the eyelids and is familiarly known as the white of the eye. The greater part is opaque, but in front it is modified, becomes transparent, and is called the cornea. The coat of the eye then is composed of two parts, the greater designed to keep out the light, the lesser especially arranged for its transmission.

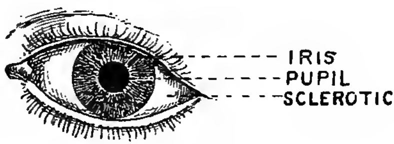


Fig. 17.

Through the cornea, like the face of a watch covered by its glass, is seen the iris. This is the coloured part of the eye. When we say a person is blue-eyed or hazel-eyed or black-eyed,

we mean that the iris is of certain light or dark tints for which custom has provided names. It is a diaphragm or stop for the purpose of regulating the amount of light passing through its central aperture the pupil. This presents the appearance of a black disc on the surface of the iris, like the patch of court-plaister on a beauty's cheek, but is in reality a hole. When the light is bright the pupil contracts, when it is duller the pupil proportionally expands. This process can be watched on anybody by merely moving them to and from a well lighted window, but more easily in the cat, though it must be remembered the cat's pupil is not circular as it is in the human being's.

The refraction of light is effected by two lenses forming together a compound lens:

1. The cornea (already mentioned) is placed in front of the iris. It has a shorter curvature than the body of the globe and is concavo-convex. It is unable to alter its curvature and therefore is always of the same focal length.

2. The crystalline lens placed behind the iris. It is biconvex, and is capable of being made more convex (and consequently of a shorter focus) when required for the purpose of viewing a near object.

The eyeball is kept in shape and its contents in position by two humours. That in front, between the cornea and the lens, is fluid and named the *aqueous*, that filling the main body behind the lens is semi-solid (like calves' foot jelly) and is named the *vitreous*.

All the refracting structures are practically transparent (though not so transparent as good glass) and together constitute an apparatus which might be correctly named a water camera.

In order properly to receive the images projected by the lenses the eye has two linings:

1. The choroid immediately lines the sclerotic. It is composed of innumerable blood-vessels arranged in a most

complicated network. It is continuous with the iris. Its inner surface is overlaid with a layer, like a tessellated pavement, of pigment cells. So is provided the necessary dark surface to prevent cross reflexions. In a few very fair people (called albinoes) the pigment is absent and great disturbance is caused by excess of light. 2. Lining the choroid and most intimately connected with it is the sensitive screen, the retina. Some idea of the delicacy of the structure under consideration may be found by remembering that it is about $\frac{1}{80}$th of an inch thick (and about half that at its central spot) yet it is divided into seven layers.

Its essential elements are innumerable microscopic structures of two forms closely packed together. They stand perpendicularly to the plane of the retina. They are of two kinds, (1) straight cylindrical rods, (2) cones, not truly conical but rather resembling hock-bottles. From these proceed (3) fine nerve-filaments which serve (like telegraph wires) to connect the retina (the receiver) with the visual centre in the brain (the transmitter). The bundle of the optic nerve leaves the back of the eyeball by a hole rather to the inner side. One group of the fibres passes to the *same* side, the other passes to the *opposite* side of the brain, so that each eye is connected with both sides of the body.

The retina is increasingly sensitive to light towards its centre. By the outer circumference we perceive large objects and are thus able to keep ourselves informed of our surroundings, but it is by the centre only that we see fine objects. Thus a man while walking may read a paragraph in a book by dint of his central vision and steer himself through a crowd of passers-by at the same time, or perceive the inequalities of the ground by his circumferential vision. The art of reading is performed by the central spot alone. When the goodness or badness of vision is spoken of in relation to school-life central vision is implied, and the fitness or unfitness of the eye for reading is the first point to be considered.

Defects of the Eye.

Refraction.

So far we have spoken of the eye as a perfectly formed instrument exactly adapted to perform its functions. If we purchased a hundred cameras from a good firm we might rely on all being equally good. One would probably be a facsimile of the other ninety-nine. But Nature is not mathematically exact, she turns out her work half finished and is at the mercy of a hundred evil influences that may mar her best projections in the course of development. Consequently the eyes met with in actual life vary considerably from the standard and are often either very ill-adapted for reading or incapable of seeing at a distance, but not fitted to either one or the other at requirement. The first condition of vision is obviously an accurate focus.

The Standard Eye.

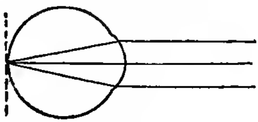


Fig. 18.

1. In the well-adjusted eye the focal length of the lenses exactly corresponds with the axis of the eyeball. Parallel rays of light are therefore focussed on the retina and a clear image formed. These eyes are adapted for parallel rays of light without using any exertion.

THE FLAT EYE. (Hypermetropia.)

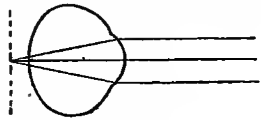


Fig. 19.

2. In a 2nd class the axis of the eye is shorter than its focal length and parallel rays of light are brought to a focus at a point *behind* the retina. In such eyes the converging pencil of light falls on the retina as a circle not as a point, and the image formed is fainter and less defined than it would be at the focus. These eyes are not adapted for parallel rays except by dint of exertion. As the lens is too weak for its position it requires rays to have a given degree of convergence in order that the focus might correspond with the retina. But convergent rays do not exist in nature and must be supplied artificially by a spectacle-lens. The majority of eyes met with in early school-life belong to this class. A more detailed description is given under the headings "The Eye in Childhood," p. 106, *et seq.*, and "Eye-Strain," p. 111, *et seq.* Here it is sufficient to recognize the nature of the defect.

THE ELONGATED EYE or Short-sighted Eye. (Myopia.)

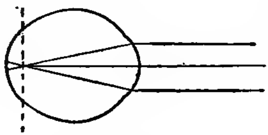


Fig. 20.

3. The over-focussed or "Short-sighted" eye. The axis of the eyeball may be longer than its focus. In that case

parallel rays of light are brought to a point in front of the retina. Continuing past the focus it is obvious they diverge and fall on the retina as circles, giving rise to blurred and faint images. As the lens is stronger than necessary it is obvious it requires rays of a certain divergence in order that the focus should correspond with the retina. Rays proceeding from near objects are divergent, therefore these eyes can focus (without exertion) objects at a given distance, but not beyond. Or the necessary divergence may be given to parallel rays by the use of concave spectacle-lenses. A great proportion of the eyes met with in the middle and later periods of school-life belong to this class. A more detailed description is given pp. 114, *et seq.*

4. *The double-focussed or astigmatic eye.* Combined with the foregoing defects due to a discrepancy between the focal length and the axis there is yet another set due to unequal curvature of the cornea. To understand this, look at your face in the convexity of the bowl of a spoon—if held vertically the face is lengthened, if horizontally it is widened. Supposing the cornea instead of being cut out of a spherical glass like a watch-glass, were a segment of a glass medicine-spoon, it is obvious the rays passing through the long diameter would be focussed at a greater distance than those passing through the transverse diameter. Therefore an eye might be under-focussed in one direction and over-focussed in another, and as rays of light cannot be brought to a focus at *one* point, as with an equally curved lens, the condition has been called astigmatism (α, privative, στίγμα, a point). This defect is frequent. Indeed the normal eye tends to be a little flatter vertically than horizontally. When this defect exists it may give rise to untold troubles, but fortunately we have the means of correcting it by the aid of glasses.

It is obvious that the vision of these eyes must vary considerably according to the difference in their refraction.

We have therefore to consider the question of

The Standard of Vision.

1. *Distance.* Vision is not to be estimated by taking objects haphazard and forming a guess whether the sight is good or bad from a successful or unsuccessful naming of anything that may happen to be seen. Mental quickness, familiarity and practice may help out a poor sight. A sailor with comparatively poor sight will see a vessel and recognise her rig when a landsman with good eyes can barely make her out on the horizon. A definite standard has been adopted and has been accepted for practical purposes by the civilized world.

It is founded on the fact that the retina cannot distinguish objects unless they are of a certain magnitude and a certain distance apart. We estimate the size of objects by the angles enclosed by two lines drawn from the extremity of the object through the optical centre of the eye on to the retina. Our impressions of size therefore depend partly on the actual dimensions of the object and partly on its distance from the eye. The apparent diminution of objects by distance is the most familiar effect of perspective. The lamp-posts near at hand appear enormously taller than those at the end of a street.

Fig. 21 makes this evident. The lines drawn from the extremities of the object *AB* through the optical centre *c* encloses the angle subtended by the arc *a*, *b*. But if an object of the same size is at a greater distance at *XY*, then the arc *yx* subtended is smaller. In order that an object placed at the same distance as *XY* should seem as large as *AB* it would require to have the dimension *PQ*. As a familiar illustration of this fact a threepenny bit held at arm's length will cover the moon's disk, which has an actual diameter of more than 2000 miles. Letters have been adopted

as the most convenient and widely needed standard. It has been determined that letters are plainly visible when seen

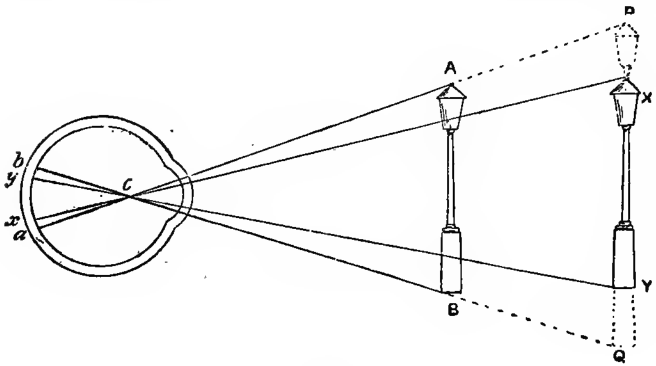


Fig. 21.

under an angle of not less than 5 minutes and their details of not less than 1 minute. Dr Snellen has arranged a table of test-types, having letters constructed to fulfil these conditions.

Testing the Vision of School-Children.

Test-types.

The types in general use are adapted for use at 20 feet and beyond. Some are made for small rooms, but nothing less than 20 feet should be employed in schools.

The letters range upwards from 20 to 30, 40, 50, 70, 100, 200 feet, or if preferred 6, 9, 12, 18, 24, 36, 60 metres. The acuteness of vision is determined by finding the smallest type that can be read at 20 feet or 6 metres.

If 20 type at 20 feet be taken to represent standard or normal vision, then it is obvious that if only a larger type can be read the vision is below normal.

The acuteness of vision is therefore conveniently and

uniformly expressed by stating the distance as the numerator and the type read as the denominator of a fraction. Thus if at the distance 20 feet the type read is 20, then vision is $\frac{20}{20}$ or 1. But if at the distance 20 feet the type read is 50, the vision is $\frac{20}{50}$ or $\frac{2}{5}$ths of normal.

20 feet. 6 metres. — 30 feet. 9 metres. — 40 feet. 12 metres.

Test letters—actual size.

To TEST THE VISION the card is hung in a good light.

The child is stationed *exactly* at 20 feet from the card and must be so placed as not to be dazzled by any light falling into the eyes.

A good selection of 20 type should be available so that the letters are not learned by heart.

A child's vision ought to be *above* the standard, but against that may be put the want of familiarity with letters among the juniors, so that if 20 is smartly read the child should be passed. (See p. 111 in relation to eye-strain.) If the child fails to read 20, the examination may be continued till the smallest type distinguishable is found and the result noted. But the business of the teacher is only with the standard. If that is not easily read it is his duty to refer the child for a skilled examination and advice.

RULE.

Every child on entering a school should be examined as to his capability of reading 20 type at 20 feet easily. Children already in the school should be examined at least twice a year to ascertain if any failure is occurring; any defect should be reported to the parents.

D—60

E

D—36

T Z

D—24

N V L

D—18

P C F A

D—12

L N T Z E

D—9

O N Z F V T

D—6

F N Y L V T Z

Test card (reduced) to shew general arrangement of letters.

The small figures (D—6) indicate the necessary distance in metres for each type in a full-sized card (*v.* p. 99).

2. Vision near at hand.

Reading and Writing.

So far we have regarded the eye as a camera adapted for distance, but unfortunately literary work has to be accomplished by reading books held in the hand or laid on a desk at a distance of only a few inches (24 or less) from the eye, and therefore at the expense of considerably greater exertion.

To see objects distinctly their images must be focussed accurately on the retina. Hence if we wish to compare the figures on a church clock a hundred yards off with those on our watch-dial at ten inches—the rays from one being parallel, the other divergent—some power of adjustment must obviously be possessed by the eye. If parallel rays are brought to a focus on the retina divergent rays would be focussed behind it and therefore either the eyeball must be lengthened (as the photographer does with his camera) or the lens must be given a shorter focus by becoming more convex. It has been proved that the latter process actually takes place. In focussing near objects the crystalline lens is rendered more convex, the greater change taking place in the curve of the front surface.

This power of altering the focal length to meet requirements is called the

Accommodation of the Eye.

When the crystalline lens is at its flattest the eye is said to be accommodated for its *far point.*

When the lens is at its greatest convexity it is said to be accommodated for its *near point.* In the former case the eye works without exertion, in the latter under exertion proportionate to the amount of accommodation exercised. Remember then that reading, writing, sewing and all *near work is only accomplished by dint of exertion.*

What increase in convexity does the lens undergo in focussing? By paralyzing the accommodation by means of certain drugs (and in other ways) it has been proved experimentally that in order to accommodate to a given distance—say 10 inches—a standard eye requires an increase of convexity equivalent to the addition of a 10-inch lens.

In the under-focussed eye the amount of accommodation needed is of course greater. Such an eye we have already learned requires to increase the convexity of its lens in order to focus clearly distant objects. In reading the amount required for distance is added to that required for the near work. Not a few of these eyes require to exercise considerable accommodation for distance. Let us suppose it equal to a 10-inch lens. Then the amount required to read at 10 inches would be equal to a lens of 10 inch focus already in action added to another of 10 inch focus for the near point—that is to say to a single lens of 5 inch focus. The enormous addition to the exertion necessary is obvious. The importance of this fact in school-life cannot be overestimated.

In the short-sighted (or over-focussed) eye it is obvious the amount required would be less in proportion.

In children the power of accommodation is enormous. In infancy the near point lies at about 3 inches. All through life the power steadily diminishes with age. Old people either hold a newspaper at arm's length or supplement their accommodation with spectacles. During school-life the *excess* of accommodation-power enables improper work to be done and irreparable damage is thereby frequently inflicted.

The change in convexity is accomplished by the action of a muscle placed immediately behind the iris and corresponding with the margin of the lens. Like muscles in other parts of the body when in action it becomes tense and hard, it uses up more blood and nerve-force. If much exercised it gains strength and size, if not exercised it dwindles. It is found to be larger in the flat-eye and smaller in the short-sighted eye

than in the standard. It is liable to fatigue, and if the fatigue is pushed beyond a certain point instead of being strengthened by exercise it is enfeebled. It is especially liable to strain and spasm, *i.e.* it is not able to relax from a position taken up. As if a man lifting a too heavy weight by bending his arm should be unable to straighten the arm when there were no weights to be lifted. In the young lenses are sometimes focussed to read print and cannot be relaxed when flattening is required for looking at a distance. Children are not unfrequently attacked in this way and appear to be short-sighted[1]. Distant vision can however be recovered by proper treatment. Genuine short-sight is of course either a permanent or, still worse, a progressive condition. But spasm of accommodation is often the beginning of permanent short-sight and should not be neglected for a single day.

Convergence.

It is obvious that in order to fix a small object like a letter at a definite short distance (say 10 inches) not only must the focus of the lens be adjusted but the axes of vision must be rendered convergent. In reading therefore the eyes are turned inward. Simple inspection of anyone reading will demonstrate that the inward movement is considerable as the book is approached towards the eye. During the act of reading a very remarkable thing takes place, not only is the convergence maintained but the side to side movements necessary to pass from one end of the line to the other are accomplished. These complicated movements are effected by six muscles which pull on the eyeball and move it in the required directions.

[1] School-work is often less to blame for this serious affection than the reading habit. Some severe cases have been observed to follow reading exciting but badly printed literature. Without investigation the schoolmaster might have been blamed for the occurrence.

If the eye turned on a pivot no harm could result from any excess in convergence. But it is enclosed in a fibrous socket supported on a cushion of fat, and the muscles in acting pull and press on the eyeball and tend to modify its form injuriously. The power of convergence varies considerably in different individuals. In some it is performed with ease but in others owing to the shape of the eyeball or a want of exact balance of the power of the respective muscles the slightest over-exertion is followed by headache, neuralgia, aching of the eyeballs or various degrees of squint.

SUMMARY.

1. The acuteness of vision is measured by types calculated to be viewed under an angle of 5 minutes.

2. The formula for noting the acuteness of vision is $\frac{d}{D}$ of which the numerator d = distance and the denominator D = type read $\frac{20}{20}$, $\frac{20}{30}$ &c.

3. The standard of good vision is the capacity to read 20 type at 20 feet.

4. When vision does not reach the standard the child should be referred for expert examination.

5. Reading and writing are effected by muscular exertion causing an increased convexity of the lens.

6. The amount of increased convexity (and therefore of exertion) required for a given distance varies according to the type of eye. It reaches its maximum and is sometimes excessive in the flat eye.

7. The excessive power of accommodation possessed by children is a source of danger as it enables improper work to be undertaken. Increased convexity of the lens sometimes cannot be relaxed at requirement.

The Eye in Childhood.

For a machine to work at its greatest efficiency it must be perfect. An imperfect or badly finished machine not only does its work badly but wears itself out prematurely. If the child's eye were perfect there might be a reasonable hope that school-work might be accomplished without much trouble.

But nature is not mathematically correct, and the eye at birth is very immature—it is not at all fit for near work.

This follows the law of other organs. At birth, for instance, the heart is not properly divided and cannot separate aerated from carbonized blood. If by chance the development of the infant heart is arrested life is generally limited to a few years. The stomach—that vital organ—cannot digest certain common foods; teeth are absent and within the first few years only a makeshift set is provided, and the general helplessness of the infant is due less to weakness as might be supposed than to undevelopment of various structures and nervous centres.

The heart is normally developed in a few weeks, the stomach in a certain number of months, and so forth, till every organ and member is perfected. The eye requires years for its full development.

Now the eye in infancy is not the standard eye, but the flat eye. All examinations of new-born children made under scientific conditions shew that the eye is always short in the axis; frequently to a remarkable degree. Under favourable conditions the eye by manhood tends to become approximately spherical and the length of the axis coincides with the focal length. Among the hill tribes of India, we are told, the standard eye is the rule. Vision is therefore perfect. Certainly among the population of large towns, and probably among the rural population of this country, the equable and perfect development of the eye is not the rule. A considerable proportion remain flat during life (arrested development),

another considerable proportion passes into the category of the short-sighted (over development). The aim of those having care of children should be to promote the just development towards the standard. The achievement of this object may be taken to imply more than mere care of the eye, it may mean a thorough understanding of the means whereby the physical development of the whole body is promoted. The perfect eye is to be regarded not merely as a good thing in itself but as a sign of well-conducted and symmetrical growth of the whole body. But examination of any school in this country—especially of any school frequented by the poorer classes of town-dwellers—will shew a remarkable absence of physical symmetry. Look at the bow-legs, the knock-knees, flat-feet, ill-made noses, lop-sided or malformed skulls and then say if it seems likely that the eyes should be optically perfect. Examinations of a vast number of eyes in school-children in the various civilized countries of Europe and America have invariably shewn an enormous preponderance of the immature, or flat, eye both before and in the earlier ages of school-life.

The standard or accurately focussed eye only exists in a minority.

In the later years the proportion of flat eyes steadily diminishes. But this cannot be taken as the result of healthy development as a very remarkable circumstance has been observed. A considerable proportion of these eyes have passed over into the class of the elongated (or short-sighted) eyes.

So that if an examination of a given school be made it may be predicted that in the junior classes the under-focussed eye will largely predominate; that in the senior classes there will be fewer under-focussed eyes, and that with every year they will be replaced by an increasing number of short-sighted eyes. The number of well-developed standard eyes only shews a slow increase. Or if an examination be made of a number

of children of a given age and these children are followed up, exactly the same course of events will be noted. Slight variations in the proportion have been made by different reporters but the main facts have been so repeatedly ascertained that they may be taken as definitely proved. Just as certainly as that the children in the lower classes are the shorter children and those in the upper classes are the taller, so certain is it that the two extreme types of eyes are found in the lower and higher forms. A tall child or so may be found dotted about in the lower classes and so may a few short-sighted eyes, but the overwhelming majority are under-focussed—the flat eye preponderates. The detection of under-focussing presents considerable difficulties and requires some skill and great patience, as in children it is often entirely masked and indeed the opposite condition simulated (see p. 103). Whenever the proportion appears under the mark the thoroughness of the examination may be suspected.

Fig. 22 shews graphically the kind of proportion of the different classes of eyes met with at different ages[1].

A represents the refraction of 100 children in the lower classes, average age being $8\frac{1}{2}$ years.

Column 1**H** shews the amount of (Hypermetropia) Flat eyes, 88·11 %.

Column 2**E** shews the amount of (Emmetropia) Standard eyes, 7·01 %.

Column 3**M** shews the amount of (Myopia) Short-sighted eyes, 4·27 %.

B represents the refraction of the eye in 100 scholars of an average age 17·5.

[1] The actual figures are taken from Dr Risley, as the examinations were conducted with scientific precision and are recent, but they differ only in small degrees from the results of other observers. Statistics are easily multiplied but they are deceptive unless the precautions taken in collection are known and unless the readers understand the value of the evidence they embody.

Column 4H shews the amount of Hypermetropia fallen to 66·84 %.

Column 5E shews the amount of Emmetropia increased to 12·28 %.

Column 6M shews the amount of Myopia increased to 19·33 %.

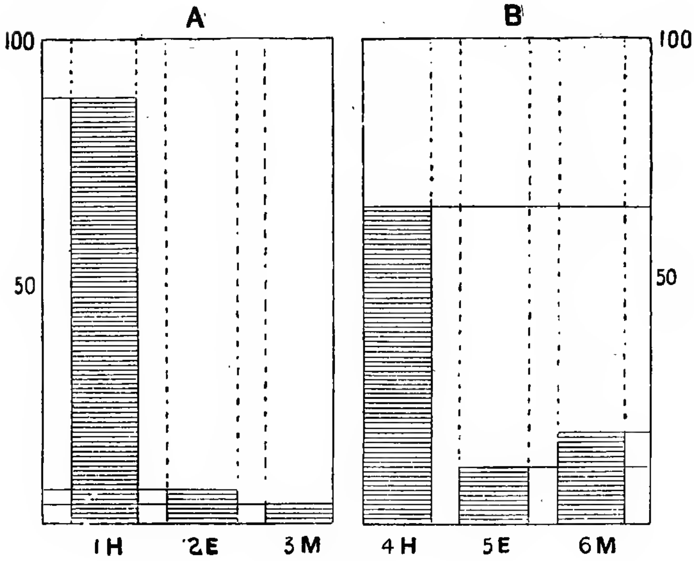


Fig. 22.

From this it is seen that the proportion of Hypermetropia falls considerably from infancy to adolescence, that the eyes are transferred for the most part to the short-sighted class, comparatively few attaining the ideal development during the period of school-life. The full development of the eye and the establishment of the stability of its tissues correspond with other parts of the body.

SUMMARY.

1. The eye in infancy is an incomplete eye, being (*a*) under-focussed, and (*β*) constructed of growing tissues.

2. It is not well adapted for distant vision, but it is altogether unfitted for near-work.

3. Development proceeds at an uncertain rate, is never completed in some cases, in others is accompanied by injurious changes leading to short sight.

4. The proportion of under-focussed eyes may appear to be less than it really is owing to the great difficulties of a thorough examination.

5. The inaptitude of the eye for near-work and the instability of its tissues give rise to the evils to be described under the title of eye-strain.

6. The settlement of the ultimate form of the eye only precedes the full growth of the body by a few years.

THE CHARACTERISTICS OF THE HEALTHY EYE.

It is clear and bright. The white is not suffused or red.

The edges of lids have the aspect of healthy skin, there is no sign of inflammation, rawness, crusts, styes, or scales at the roots of the eyelashes. The eyelashes do not tend to fall out. There is no watering on facing bright light or moderate winds, or in reading small print. Strong light is faced without flinching and no discomfort is experienced in opening the eyes after sleep.

The vision reaches the standard and reading can be (though it ought not to be) maintained for hours without fatigue, pain or headache.

Every teacher should be capable of ascertaining if these conditions are fulfilled in his pupils. It is not his business to discover *what* is wrong but merely to know when something is not right and to refer the child for a competent opinion.

Eye-Strain.

Symptoms of eye-strain may arise whenever there is any impediment to the distinct vision of near objects, and are more especially liable to occur when the defect can be remedied by an undue exertion of the muscles of the eyeball. In other words small defects give rise to more pronounced symptoms than great defects. The explanation of this apparent paradox is simple. When a defect is so great that it cannot be overcome the eye does not attempt the job, no exertion is made and consequently no symptoms occur. Thus a dense white scar on the front of one eye may altogether obscure small print. As the eye does not see, it makes no attempt to see. Reading is then done by the other eye alone and with comfort. But supposing the film is so thin, that letters can be read by dint of holding the book a little closer to the eyes, then both eyes endeavour to act in concert and under unfavourable conditions, and various pains and aches or even permanent injury may result. In the same way if no reasonable amount of muscular exertion will overcome a given high degree of focal error then the eye is content with not seeing at all or seeing with a blurr and no ill arises. But low degrees are easily overcome by slight exertion which though easy in itself may by constant and prolonged application give rise to pain or permanent disablement.

Any focal maladjustment or impairment may give rise to eye-strain, but by far the most frequent cause is the undevelopment of the eye, and the symptoms accompanying that condition may therefore be here considered.

The Flat Eye.

The vision of these eyes *may* be perfect, and distant vision may be maintained indefinitely without fatigue as by standard eyes.

But in near vision certain peculiarities are shewn. Small print may be read with ease in a mere test experiment, but prolonged reading—the amount varying from a few lines to many pages—gives rise to symptoms of fatigue.

Letters begin to dance or wobble. Mistakes are made in easy and familiar words, finally the words run together into a grey mass and nothing is distinguishable. A short rest, a closure of the lids, a rub with the knuckles and the task can be resumed, to be ended in the same way generally after a shorter period. This tendency of certain children to read well at the beginning of a paragraph and to blunder towards the end is well known to teachers, but is generally attributed to a "want of attention." An unlucky guess, as it is obvious that the blundering is due to too much attention and not to too little. Children who are markedly slow in learning to read are frequently found to have this defect. Mental deficiency sometimes exists but it is comparatively rare—in the vast majority of cases the eyes and the eyes only are at fault. Children seldom call attention to this defect of vision (or to any other subjective sensation that does not amount to actual pain) because in their inexperience they assume that whatever is is right. Ignorance is not always bliss. But if under the circumstances a determined push is made with reading and writing the tired nerves resent the strain and pain results. Aching of the eyes occurs, often not at the time of exertion, but hours after or even the next day, as the inexperienced rider feels his stiffness not in the saddle but next day on his office-stool. Or the pain may be reflected by a nerve, and radiate a considerable distance from the eye, constituting a "neuralgia." In these cases the eyes are frequently not even suspected but all sorts of nostrums are prescribed and teeth are extracted with lamentable zeal before having recourse to the true remedies, rest and glasses.

General headaches varying from slight malaise to downright disabling "sick headaches" are frequent. Children undoubtedly

suffer from headaches from various causes but those from eye-strain far outnumber those from all other causes put together.

Overstrain may be detected by various outward signs. BLINKING and WINKING. The eyelids are rapidly and repeatedly closed, especially on exposure to light, as in facing a window or while regarding objects attentively. In slight cases this blinking will subside after a day or two in the country. In more severe cases it persists even after long rests and careful optical treatment. The twitching is at first generally confined to the eyelids, but sometimes spreads to other muscles of the face—the angles of the mouth and nose, the cheeks moving spasmodically, and even down the side of the neck. The movements are occasionally grotesque and are supposed to be tricks—but tricks in childhood have but a short vogue and tend to be quickly changed for something new, whereas these spasms tend to get worse instead of better if work is persevered in. The resemblance to St Vitus's dance is sometimes so close as to lead even professional men astray.

Accompanying the foregoing symptoms, or separately, we may see signs of CONGESTION, or inflammation. The whites of the eyes become red and suffused, tears are frequent and copious. There is a general aspect of having "caught cold" or a look of having been crying.

REDNESS and SORENESS of the edges of the lids. Small crusts or fine scales form at the roots of the eyelashes, which are sometimes shed. Styes occur with frequency.

Finally these children SQUINT. No squinter should be allowed in a school without a medical certificate.

In observing cases of eye-strain we cannot fail to note that out of a number of children with focal defects only a certain number are inconvenienced, the remainder though equally under-focussed do not suffer. From this we infer that pain is the resultant of a combination of two circumstances, one the structural imperfection of the eyes, the other a want of

fortitude in the nervous system. Remarkable variation in the sensibility to pain is shewn in different individuals, and as a rule it may be said that it varies according as the physical health has been neglected or cultivated. The intellectual worker with muscles undeveloped and a brain overworked will suffer torments from trifles that a navvy would scarcely feel. And therefore in all cases of eye-strain where pain is a marked symptom we must be on our guard against a nervous system overtasked by work or growth, or an inherited neurotic or other degenerate constitution. The great majority of these cases can be relieved by properly adjusted glasses and work comfortably alongside their unspectacled school-fellows, but there remains a small body of unfortunates whom no glass relieves. In spite of the most skilful treatment and assiduous care their pangs continue. They should be packed off to the country. They often do admirably if allowed to run wild for six months or so in a farm. Or they should be sent for a voyage. But on no account should they be allowed to continue at school.

The foregoing symptoms are characteristic of the flat eye but may arise in other varieties of defective focus or impaired vision.

Short Sight.

Short sight is by far the most important condition of the eye connected with school-life, partly on account of its far-reaching consequences and partly because educational methods are directly responsible for its inception.

A short-sighted person sees clearly at a definite finite distance, it may be a few feet or only a few inches, but everything beyond this point is hazy or ill defined.

A child should be suspected of short sight when it reads a book easily but makes mistakes over the wall diagrams or the work on the blackboard.

No suspicion of the early stages of short sight may be excited by observation of the child's power of seeing natural objects. For the recognition of the vast majority of things a sharp outline is not necessary, though for the recognition of a letter (or precise form) it is of primary importance.

A haystack or a sail or a house are equally recognizable with a blurred or with a sharp outline.

It is therefore often supposed because two persons can see a haystack or a sail distant some half a mile off that both are equally "long sighted"—is not half a mile half a mile? Even letters may be deciphered provided the blur does not wholly obfuscate the open spaces. Thus the short sight of many children may escape detection of rough and ready observation.

But if a child reads small print easily at a certain distance from the eye (*e.g.* a book held in the hand) and cannot read the distant type (20 at 20 feet) he may be suspected of becoming short sighted.

Slight degrees of short sight may be considered no disadvantage (or perhaps even desirable) for many urban occupations. But the advantage ends with the slight degrees. No apology can be made for the pronounced degrees—Men otherwise fitted are inexorably rejected for the Royal Navy, they are less rigorously excluded for the mercantile marine and the Army, they are handicapped as emigrants. They are more or less dependent on spectacles throughout life.

THE TROUBLES OF THE SHORT-SIGHTED.

In addition to the inconvenience caused by the limitation of the range of vision short sight may imply a certain amount of internal mischief, pain, and ultimate destruction of sight.

The short sight as met with in schools may be conveniently divided into three categories.

1. With a slow and benign development. These eyes pass from the flat-eyed to the elongated type gradually without pain or symptoms. They progress slowly or almost imperceptibly up to a certain point and then remain stationary, giving no trouble in the future. These eyes are strong and well suited for urban occupations.

2. With a fitful and irregular rate of progress—greatly influenced by the favourable or unfavourable conditions under which they are placed. The rate and amounts often differ in the two eyes so that one becomes more short sighted than the other. After a time progress tends to be arrested, especially if the eyes are not overworked. Once settled the tendency to make a new start is not marked, unless some especially trying occupation (like engraving) is taken up. Although some wasting of the choroid coat of the eyeball is seen, the mischief is unimportant and the vision remains good albeit limited in range.

3. The tendency to progress very marked and easily accelerated by injudicious use of the eyes, constitutional weakness, etc., but not the same tendency for progress to be stayed by rest and remedial measures. Once started some extreme and rare cases seem unable to withstand even the ordinary work of daily life—reading letters, looking at magazines, illustrations in the papers and such occupations as can scarcely be avoided in the present day. Cases of this kind suffer extremely from school life. The short sight increases from term to term. The slightest over-pressure, as in preparation for examination or even the close perusal of an exceptionally interesting book, is followed by a disproportionate amount of injury. Although all short sight tends definitely to stop between 20 and 25 years of age, some of these progressive cases are found getting worse even in middle life.

These categories are not separated by abrupt lines but insensibly merge one into the other. The mildest cases may be regarded with indifference as little more than a peculiarity

of development, whilst the most severe must be viewed with alarm as a mischievous and destructive process often ending in serious deterioration of the sight or even blindness at least in one eye.

It is popularly said "a short-sighted eye is a strong eye." This is a fallacy derived from an imperfect generalization. It has arisen from the fact that short-sighted persons have been observed to read small print without glasses in middle life and even to extreme old age. Eyes belonging to the first category, and a proportion of those belonging to the second, may be considered as eyes having the same strength (*i.e.* resistance) as those of normal development.

But a very large proportion of short-sighted eyes are weak eyes, of poor resistance and continually giving trouble. For example, to take one type of mischief, as the weakness progresses more and more difficulty is experienced in fixing a given letter with both eyes, and in the final stage one eye gives up the task, wanders outwards and a squint is established. At first (and in slight cases) this is not visible, but after a time it amounts to a deformity, altogether altering the facial expression. Short-sighted eyes are also extremely liable to a detachment of the inner layer and consequent blindness.

Therefore short sight must be regarded in childhood with suspicion, as though beginning in a trivial complaint it may end in the most serious catastrophes in middle life.

What is the duty of the teacher in the matter of prevention and management of short sight?

In the first place it is becoming more and more probable that congenital short sight is either non-existent or very rare. Apart from certain cases of disease and faulty development, the vast preponderance of all short sight is acquired, and is a purely artificial condition, induced by the misuse of the eyes during the period of growth. The particular evil is the employment of the eyes at fine work at a short distance, and as the majority of children are employed in school in reading,

writing, and sewing, these occupations may be considered the main causes.

It is now universally admitted that short sight is (1) rare before the beginning of school-life (*i.e.* between the first and the sixth year); (2) that it is greater in amount and degree in town schools than in rural schools; (3) that it increases in amount and degree in the higher classes; (4) that it increases according to the number of hours a day employed in literary work; (5) that under the same conditions it is worse in badly lighted than in well-lighted schools.

Briefly, short sight may be said to be the result of faulty methods of education[1]. If this be admitted it is evident that a reform is needed in our system of dealing with the young (if not in other matters at least as regards their vision) and that the co-operation of the State, of medical men, parents, and teachers is earnestly to be desired. The evil conditions calling for watchfulness and care are somewhat as follows.

I. *Faulty conditions inherent in the pupils themselves.*

Short sight may be observed developing in school-children with the following factors existing as defects and so far independent of the conditions imposed from without.

(*a*) *Predisposition* (*from whatever causes*) *to special eye weakness.*

(β) *General weakness unfitting children to withstand the strain of school-life.* For instance, children who have indefinite brain or nervous troubles are observed to be subject to internal eye disease leading to short sight.

(γ) *The incidents of convalescence from disease.* The debility induced by measles, scarlatina, typhoid and other febrile

[1] This statement does not exclude the fact that many employments have very disastrous effects. Engravers, architectural and other scale-draughtsmen, compositors, clerks, etc. suffer severely.

disorders is frequently a starting point. The discontinuance of reading and writing during convalescence, not only in school but for amusement, is to be strongly urged. Books moreover assist in spreading infection, especially after scarlet fever.

II. *Faulty conditions imposed by teachers.*

(*a*) *Long hours* are harmful in a positive and negative way. They give rise to *too prolonged* congestion of the blood-vessels, strain on the accommodation and convergence, all of which are injurious in proportion to the time they are maintained, and they do not allow sufficient intervals for rest and recovery, so that both local and general powers of resistance are lowered. Reading is physical exertion differing in no respect from other physical exertions except in the delicacy of the structures involved.

Teachers may therefore err in making the tasks too long, in putting tasks of a literary nature in too close a sequence, and in not taking the eyes from near-work and expressly setting them to look at distance between whiles.

(*b*) In addition to literary tasks already excessive we find (surviving from an ignorant and coercive past) the custom of "*impositions.*" It is enough here to insist on the fact, that if ordinary schoolwork is already overburdening the eye, any addition out of hours should be forbidden.

Punishment inflicted out of school hours should not involve use of the eyes for near-work. Moreover detention in schoolroom prevents the windows being thrown open widely as they should be and the room thoroughly flushed with air as soon as it is vacated.

(*c*) *Excessive amount of writing exercises.* The amount of penwork done, especially by girls in schools, is amazing. Not only do they write out the greater part of their lessons, but they keep journals or registers of the work done. There is a superstition that writing strengthens the memory. A

little patient observation would shew it does nothing of the sort. Its true business is as an aid to the classification, arrangement, and coherence of thought and for that need only be sparingly employed. The necessary details for the right conduct of writing are given under a separate heading, pp. 131, *et seq.*

(*d*) *Undue home lessons.* To take the evening when the brain is more or less fatigued with the exertions of the day, when the oncoming of restorative sleep dulls the perception, as the time to make the chief call on the acquisitive faculties is obviously to put them to work at a disadvantage. Morning is the time to learn, it is the period of wakefulness. Then perception is most alert, memory may be trusted, and tasks can be accomplished with the least possible expenditure of energy and time. More obviously is this the case with the eye. It, of all the organs, has the most marked premonition of sleep. When this stage is reached it stands to reason that this is the wrong time to revive the flagging energies of this organ, to excite its circulation and reiterate the changes of its nervous system when repair is already needed. Moreover, in vain do we consider carefully the lighting of schoolrooms, the arrangement of desks, the printing of books, if the responsible work of the eye is carried on under the unfavourable and ill-supervised conditions of home life. In the homes of the poor even fairly suitable arrangements are often wholly impossible. However difficult the reduction of homework may be from the point of view of school organisation, the oculist has no hesitation in affirming that home lessons are amongst the most perilous causes of defective vision in the young.

Faulty conditions imposed by the printer.

In judging the suitability of a book for school use the first point to be noted is the *paper*. It must be opaque, and not too thin or it will allow the print on the other side to shew

through. There should not be any sign either from inkstain or pressure to shew that there is printing on the other side of the page. Note especially the effect of illustrations in this direction. Newspapers even if printed from good type are often quite indistinct, and trying to the eyes on account of this defect. Books are occasionally bound and pressed before the ink is dried and a faint impression of the opposite sheets causes a haze.

White paper affords the best contrast with black type, but pure white, owing to irradiation, rather diminishes the thickness of the strokes. But no positive tint has been found beneficial, though many have been tried. Old-fashioned *unbleached paper* of a faint tawny grey is most generally acceptable. The *smooth glazed* surface, now greatly in fashion, is highly objectionable. It gives rise to dazzling, and in certain positions the reflexions, especially from artificial lights, render the print almost invisible. It has crept into use from giving a fictitious appearance of finish to illustrations and type. It must be rigorously excluded.

The types in common use are the following:

Name	Height of letters	Specimens
Brilliant	0·75 mm.	a e i o u 5 3
Pearl	1·0	a e i o u 5 3
Minion	1·25	a e i o u 5 3
Bourgeois	1·5	a e i o u 5 3
Small Pica	1·75	a e i o u 5 3
Pica	2·0	a e i o u 5 3
English	2·5	a e i o u 5 3

It is obvious from what has been said that any of these types are visible provided only they are held sufficiently near the eye. Therefore the mere visibility of a type is not the criterion of its suitability.

The prime necessity in a type for children's use is that it can be read at some distance from the eyes, and that distance

for learners ought to be considerably greater than would be convenient for a practised reader. Putting aside beginners (who ought to be taught from wall placards) the lower classes ought to be provided with type of a size that can be read fluently at a minimum distance of 24 inches. For instance, in learning a task of poetry or a conjugation, the child ought to be able to lean back in his seat and read from the page propped up on the far side of the desk. Holding the book in the hand is a custom having nothing to recommend it but convenience, and though not likely to be discontinued by adults, should be discountenanced in children.

In measuring the size of types the breadth is more important than the height, which in itself contributes little to legibility, though letters in use are usually about one-third higher than broad. As a standard the short tailless letters that occupy a space nearly square are to be taken. These, as they are usually drawn, should measure 2 mm. in height and at least 1·50 in breadth. Experiments shew that letters of this size are read fluently by adults at 24 inches. They correspond to Pica. This may be selected for the upper classes. For the lower classes and for learners it is advisable to have a larger type.

2. *Thickness of the stroke.* Much pretty looking type is unduly thin in the stroke. Printing began as an imitation of writing where the up-strokes are necessarily thin and the down-strokes thick, but in a mechanical fount there is of course no meaning or advantage in having one part of the stroke thicker than another. But forms are imitated long after the reasons for their adoption have ceased to exist and consequently a vast amount of printing illustrates the pride taken by the workman in his capacity to turn out hair lines rather than his understanding of the qualities that contribute to legibility. Reading is accomplished in the main by observing the differences in the shapes of the upper portions of the letters. Therefore the best type is that which marks

out those differences most clearly. The arches of the m, n, the openings in v, u, w, x, the horizontal line in the e distinguishing it from c should be perceived at a glance. Observe that an unduly thick stroke infringes on the open space and therefore may contribute to illegibility.

Italics are difficult and should only be employed for occasional emphasis.

4. The distance between the letters. It is obvious that the spacing between two letters has the same requirements as the open spaces in the letters themselves. Thus if we recognise the m by the two arches connecting its uprights, we ought to be able with the same facility to recognise that two adjacent letters are not connected by any tie.

m, nn, nu, nv, w, in, or words like *immense*, *murmur*, *minimum*, *mere men*, depend greatly for their easy recognition on the spacing of the letters. The spaces between two letters should not be less than half the width of the letter.

Printers are fond of encroaching on this valuable space by ornamental finials. Thus they prefer uwvy to uwvy because it gives the aspect of a nice even top. But the reader does not want a nice even line, he requires an edge with salient differences.

The intervals between words should be emphatically marked. For practised readers too great a separation of words is not advisable as it retards. A space of not less than double the width of the letters may be taken as a good working distance though more may be advantageously allowed for learners.

1. Some men amuse more than others.
2. Some men amuse more than others.
3. Some men amuse more than others.

It is obvious that arrangement No. 2 is the easiest to read for adults, but nevertheless an arrangement similar to No. 3 is best adapted for learners.

The distance between the lines. Leading. Reading is much facilitated by an ample space between the lines. Poetry

and three-volume novels may be taken as typically well arranged books, though the motive is rather to spread a little matter over a wide space than to ease the work of the eye.

It has been asserted that separation of the lines is not of importance, but experiments have convinced the writer that ample leading is one of the most efficient means of reducing the labour of reading. A comparison of specimens indicates that the difference in the appearance of solid and leaded lines is greater than could possibly be surmised.

Solid.

Under the reign of the last Stuarts, there was an anxious wish on the part of Government to counteract, by every means in their power, the strict or puritanical spirit which had been the chief characteristic of the republican government, and to revive

Thin leaded.

Under the reign of the last Stuarts, there was an anxious wish on the part of Government to counteract, by every means in their power, the strict or puritanical spirit which had been the chief characteristic of the republican government, and to revive

Double leaded.

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The length of the lines. The longer the lines the greater to and fro movements must be made by the eyes, and consequently the greater fatigue in reading a given number of words. The less the distance which the eyes have to travel the better. The length of a line as determined by printers in quarto and large octavo books is too long, but the customs of compositors need not be inexorable. As determined by our literature the length of our line is mainly influenced by our ten-syllable blank verse and fortunately may be well printed in lines of a comfortable dimension. In Dyce's Shakespeare, in 100 consecutive lines only 17 exceed 3 inches, some are less. The prose passages in the same play are $3\frac{5}{8}$ths inches. In a library edition of a standard history the lines are $3\frac{6}{8}$ths. The column of a first class daily newspaper is $2\frac{5}{8}$ths. In books specially prepared for children, a well-printed work on outdoor life had lines of 5 inches, a large print book of general information $4\frac{7}{8}$ths. A popular French grammar $3\frac{6}{8}$ths, a German grammar $3\frac{1}{4}$th, a reader $3\frac{5}{8}$ths, a

geography $3\frac{1}{8}$th. So that on the whole the poet and the general editor may be said to do better for us than the special providers.

A general maximum of 3 inches may fairly be adopted as a standard, and books with lines much exceeding that length should not be used for continuous reading.

Arrangement of matter. Printers, aiming at a mechanical uniformity, like to see the upper edge of their lines as even as possible, and all the lines of the same length. The eye prefers exactly the opposite conditions. It prefers a well-varied upper edge and lines of differing length.

The modern advertiser, who understands human nature and who wants the qualities of his goods appreciated at a glance, runs directly counter to printers' prejudices, and "displays" his matter by all sorts of ingenious variations of type-setting. No uniformity for him; nor should there be for the school-printer.

The paragraphs should be as short as possible[1]. When lines end in the middle of a word, the whole word should be carried to the next line and not be hyphened. Nor should the spacing of letters be needlessly varied. Thus German printers, using roman type, have an annoying trick of separating the letters of words for the sake of emphasis or filling the full space of the line.

Here is an example of the printers' love of neatness leading to a bad arrangement:

> For mankind an absolute monarch, with the most perfect military machine in Europe at his command, Frederick is constantly spoken of as a man typical of his century. In truth he was throughout his life in ostentatious opposition to his century on its most remarkable side.

[1] The arrangement of verses in the Bible is excellent. If the Bibles (or separate books thereof) supplied to school children were printed in good sized type (and not as they often are in exceptionally small type and on thin paper) they might be considered as good models for school printing.

A child's eye would have to wander from "per" to "fect" and back to "per" again before the whole word could be grasped, and so on.

Except at the beginnings of paragraphs the left hand should be vertical, with as free a use of capitals as possible, but the right hand may be advantageously varied.

Dialogue is the example of easy reading. Vocabularies and glossaries should never have the first letters small. A ruled line assists the eye in running down a list of words. It is generally used only to divide columns but it may be advantageously used as a guide to the eye in children's glossaries. Underlining horizontally for the sake of emphasis is on the other hand distracting to the eye.

Remarks on special subjects.

Music. Girls frequently volunteer the statement that music is more trying to the eye than reading. The lines are too long and the conditions of reading very complicated. The eye has to travel horizontally along the lines of the stave, but at the same time be continually moving up and down vertically to follow the position of the notes in the scale and their relation in the treble and the bass.

Moreover a quantity of music is now printed cheaply by lithography and other rough and ready methods.

Some is very small.

Only well printed full-sized music should be used in teaching.

Special large sheets have been prepared for beginners and should be used.

They are known as the giant notation.

Greek. Boys complain of Greek. The type is really easier to read than Roman of the same dimensions, the forms of the letters being well varied and the upper openings well

defined. It is the unfamiliarity that renders it difficult and not its essential qualities.

German, on the other hand, has a radically vicious type with very ill-placed hair lines at the top of the letters. Germans themselves, bred to it from their childhood, suffer considerably from its imperfections and our children have to contend with the additional difficulties of unfamiliarity. It is likely to die out before long in its own country and may therefore be only sparingly employed in our schools.

Maps may be instanced as having type much too small. Modern processes permit the production of most beautifully executed little maps at a very small cost, but though creditable to the workman they are exceedingly bad for the eyes. The lettering is moreover confused by names of districts and provinces sprawling irregularly among the names of towns, by the meandering of rivers and the shading that symbolizes mountains. Moreover the contrast is diminished by the colouring of divisions. Children having to find out the position of a town set to work by searching for the name by means of their forefinger, and in the effort to find one name they may have to read a hundred. The use of the index and the latitude and longitude was certainly exceptional in schools visited. Teachers seem indifferent to, or unconvinced of, the value of large wall maps and the practice of the pupils themselves drawing maps either from pattern or from memory on the blackboard. In schools where the custom is seriously adopted the advantages are generally marked, and the abolition of small maps may be confidently expected to follow the spread of this particular method.

Summary.

Short sight is a malformation of the eye, varying from a slight elongation, scarcely distinguishable from an excess of development, to a marked bulging of the back of the eyeball accompanied by inflammatory and destructive changes.

Vision may be exceptionally good for fine work close at hand, but below the standard for distance unless aided by spectacles. Severe cases are accompanied by deterioration of both near and distant vision.

Short sight in low degrees is well adapted for urban occupations, but in varying degrees is inadequate for outdoor life, *e.g.* soldiering, sailoring, emigration, etc. Short sight is not strong sight, and in severe cases the sight is often in great peril during middle age and advanced life.

A large amount of short sight is progressive not only as regards deterioration of vision but as regards changes in the structures of the eye.

Short sight is due to the employment of the eye in near-work, reading, writing, sewing, etc. The amount of damage inflicted on the eye is influenced by the immaturity of the eye, its especial proclivity and unfavourable conditions under which it is exercised.

The entire prevention of short sight cannot reasonably be expected, but much may be done to reduce the amount and degree.

The hours employed in literary work should be reduced and literary tasks alternated with bodily exertion or employments not needing the eyes. Written impositions should be abolished, home lessons if not forbidden most carefully supervised.

Increase in the use of wall diagrams, in the use of the blackboard both for teaching and learning, and in oral instruction.

Books must be carefully chosen and great attention paid to the quality of the paper and the printing, the legibility of the type and the arrangement of matter.

Reading must never be practised except in a good light.

Finally, short sight implies injury to an important organ, deterioration of a faculty and possible loss of an invaluable sense. Education implies the cultivation of every faculty and the improvement of every sense to the highest perfection possible in the individual endowment.

CHAPTER X.

SCHOOL FURNITURE AND WRITING.

THE question of seats and desks has attracted great attention, but in the voluminous literature which has grown up around the subject there has been too great an insistance on the necessity for perfect furniture and too little on the proper management of growing children—thereby diverting the teacher's observation from the essential points. Many possessors of patent desks have indeed been lulled into a false security and led to suppose they could not go wrong so long as their mechanical contrivances were right, and have in consequence persevered in long hours and much writing which they would have discarded if they were thoroughly convinced of the injury likely to be inflicted. A good desk is undeniably better than a bad desk, but it cannot in the nature of things be free from all bad qualities, it preserves some whilst mitigating others, and it may be so injudiciously used that it may actually be inferior to common household furniture employed in a rational and careful manner. The charge preferred against seats and desks is of promoting short sight and distortion of the spine. The charge is to this extent true that the occupation specially carried on at the desk is writing, and this, confessedly a bad employment for adults, is one of the worst to which a child can be put. Carried out under the most favourable conditions it means a strain on the eyes and the bones of the trunk, which those organs are by no means adapted to resist.

THE SITTING POSTURE. Both in standing and sitting the body is supported by the skeleton. But the skeleton will not stand alone, it bends at the joints unless balanced by the opposing tension of muscles which draw upon the bones in various directions and keep them fixed in the necessary positions, much as the ropes in a ship brace the yard-arms at the necessary obliquity to catch the wind.

Standing and sitting are therefore not positions of rest but of modified activity, the immediate exertion is not so great as in movement, but is more continuous. Thus in rowing the body is moved to and fro. In the forward movement the muscles in front of the trunk etc. are contracted, those of the back correspondingly lengthened, but at the pull the back-muscles are contracted and the front lengthened. This alternation of lengthening and contraction is *exercise*. But in sitting the muscles assume a certain degree of contraction and keep it. Thus in stooping slightly forward as in writing the body is held up by the requisite contraction of the back-muscles continuously exerted; there is no alternation of contracting and lengthening as in active movement. This maintenance of one position by the prolonged and unrelaxed exertion of muscles is not exercise but *strain*. Exercise is healthful, strain harmful. In the act of sitting, the body is supported on the haunch-bones which form an arch from side to side, so that there is very little tendency to fall either to the right or left, but from before backwards these bones have only a narrow curved surface which affords little more base than a soda-water bottle, so that the equilibrium resembles that of a rocking-chair on a pair of very short rockers. A little assistance is given behind in maintaining the balance of the body by the hidden remnants of the tail which terminates the backbone. But if the muscular support is withdrawn the body either falls forward or backward according to its inclination. As a rule a writer sits fairly upright for a time, until the supporting muscles of the back become fatigued and he then

leans forward and supports his chest on the edge of the desk or on his elbows. How then is the body kept upright in sitting? By the action of the muscles using the thighs as a base.

THE SEAT. The first requirement of a good seat is adequate support for the thighs. The depth of the seat should be just a little shorter than the underside of the thigh, measured from the buttocks to the bend of the knee. It must not be longer, otherwise the haunch-bones cannot rest against the chair-back.

In order to render the base more firm the feet should rest on the ground or on a footstool. The height of a seat should not exceed the length of the leg measured from the bend of the knee to the heel. The foot should rest easily on the floor. The base is further strengthened by supporting the back of the haunch-bone and hindering it falling backwards. A cross-bar support should fit the upper part of the haunch-bone just below "the small of the back." This support loses some of its value if too high, as it then impinges on the flexible part of the backbone, where it is not wanted. A low-backed chair of this kind fitted to the size of the child reduces the evils of the sitting posture in writing to a minimum. If the chair is needed for resting—*i.e.* leaning back—the back must reach as high as the shoulder-blades and slope backwards from above the cross-bar. The wooden chairs made for kitchens are often scientific in construction and thoroughly restful. Of course they are too large for children. The music-stool is the worst seat yet devised.

In cases of spinal deformity the chair-back must be specially made to fit under the direction of the surgeon.

THE DESK. If the desk is too much separated from the seat the writer must lean forward, if it is too low he must stoop, if too high he must raise his elbow and shoulder to reach up,

The edge of the desk should therefore come well over the seat.

Its height from the seat should be the interval from the seat to the elbow, the arms hanging by the side, the forearms flexed at right angles. The writer should be able to sweep both forearms easily over the desk while he is sitting bolt upright and both elbows level with his sides. If these conditions are fulfilled it is easier to sit upright than crooked. With a thorough understanding of the guiding principles the village carpenter will make seats and desks of a suitable character, the simpler the better.

The one essential requirement is to have the furniture suited to the size of the pupil. The pupils must be classified according to the length of their bones and not according to mental ability.

For home teaching the ordinary tables and desks can be used if the chair is made with adequate length of leg and a proper foot-rest so that above conditions are fulfilled. In schools it is advisable to have furniture of varying dimensions. Mr Priestley-Smith considers four sizes are sufficient. The following figures are taken from his specification and will serve as a guide for those who have to furnish. Mr Priestley-Smith has designed a desk and seat fulfilling all ordinary requirements. There are many others in the market.

	ft. in. ft. in.	ft. in. ft. in.	ft. in. ft. in.	ft. in. ft. in.
Height of Scholar	3 6 to 4	4 to 4 6	4 6 to 5	5 to 5 6
Height of seat from floor	13	14½	16	18
Breadth of seat	10	11	12	13
Height of desk and back from seat	8	8¾	9½	10½

In the patterns supplied by school-furnishers desks and seats are so constructed that they can be readily adjusted as required. But with a due attention to the growth of a child much harm is not likely to occur if the dimensions of writer and desk fairly approximate. Injury is not inflicted by the *temporary* use of a bad desk, but the reiterated assumption of a bad attitude and day by day engaging in an occupation which always puts the strain in the same parts may ultimately so twist and distort the body that the deformity becomes visible to the most uninstructed eye. There is a slight difference in the proportions of girls and boys. Girls are relatively longer in the body and shorter in the limbs, and therefore require the desk rather higher from the seat; ¾ of an inch is the usual allowance. The question of the change of attitude must be considered. When the seat and desk are in the proper position for writing the pupil cannot of course stand. He must push the seat back or the edge of the desk forward. The former is the more convenient arrangement. Some patterns of desk are provided with flaps which turn up when the pupils require to stand—under certain circumstances as when the row of seats is against a wall this answers, but as a rule the readily moveable seat will be preferred. To rise, to set back the chair, to stand at attention entirely free from all furniture, with no possibility of leaning on anything is a good beginning of the necessary relief from sitting. In fact all school furniture should be as light and portable as possible, so that it can be moved in order to allow the floors beneath to be thoroughly and frequently scrubbed and when practicable to be moved entirely out of the room.

Desks are better made to serve as desks only and not as lockers and bookcases which collect dirt and are difficult to clean. They should be kept thoroughly polished all over with beeswax and turpentine. Well polished wood shews up dust and harbours but few germs. The work of polishing is excellent exercise for the pupils and helps to make them

handy. Teachers may well imitate those naval captains who point to the state of their decks and their brass as indices of the efficiency of their crew. There is an educational as well as a hygienic advantage in teaching children to take a pride in the smartness and cleanliness of their school-rooms and in allowing them to contribute actively in the work. All lockers, cupboards, and shelves should be periodically emptied and thoroughly cleaned, books dusted and put out in the open air.

CURVATURE OF THE SPINE. If you pass your hand down the back of a child you will note a convexity between the shoulders and a concavity at the loins. These are the natural curvatures of the spine and are very graceful and pretty to behold. But if you view the line of the spine from the nape of the neck to its lowermost point you will note it is exactly perpendicular and has no deviation to the right or the left. If at any part it has a bend, that must be regarded as a deformity.

A certain proportion of school children, especially girls, suffer from this complaint, and special authorities on the subject attach great importance to the evil effects of writing. How does this occur? We have already learned that the spine supports the weight of the body. In adults the bones are hard and capable of so doing. But in children the bones are comparatively soft and pliable. The same amount of force that will snap the armbone of an adult will only partially break it in a child so that it is bent but not broken through. A fracture of this kind is aptly named "green-stick," and if the child is allowed to grow up without surgical aid the bone will be bent, though strong. The Chinese lady's foot is another example of the flexibility of young bones.

The spine consists of a number of disks piled one on the other, they are soft and therefore compressible, they are growing and therefore tend to expand in the direction of the least resistance. If the weight is unequally distributed or there

is a persistent pull of the muscles in one direction (which amounts to the same thing), the verticality will be lost and a curve is begun. The whole mechanism of the body is so complicated that one part cannot be altered without affecting other parts and compensatory curves and deformities immediately follow on the first defect. So it happens that the parents of these children first notice an ugly projection of the right shoulder-blade and it is not till they are taken to the surgeon that the real nature of the deformity is suspected.

If one of these children is examined nude, the curve in the spine may or may not be visible to the unpractised eye, but almost always there will be noticed a dropping of the right shoulder, a projection of the lower tip of the shoulder-blade, and a raising of the right hip. Obviously in a child such a tilt must imply further deviation from the perpendicular in the course of growth. Slight cases carefully treated recover so far that the deformity is scarcely visible, but cases that are allowed to progress often grow up with a crooked back that implies not only a loss of appearance (which in the case of girls may count for something) but an insufficient development of chest. Remember the desk and seat are only contributories to some causes already in existence. The sitting posture is bad and tired muscles are bad, but awkward sitting would not be indulged in nor would the muscles too readily fatigue if there were not behind all a general debility of system. The children who suffer in this way have generally feeble, ill-nourished muscles—they have been brought up with too little physical culture or the muscles may not be in proper exercise at the time. To put a muscle on the strain after it has been at rest for some time and after it has been well vivified by exercise is to act on two different things. There should be always exercise before a writing lesson to stimulate the resistance of the trunk-muscles and after to restore their tone, and as writing is a lop-sided occupation movements of both sides are to be commended. In fine weather almost any active

game with a good deal of running and catching (like prisoner's base) will do. In wet weather a few minutes' dumb-bells before sitting down, and a tug of war (best two out of three) in the corridor after the lesson may be recommended. Remark that exercise of the muscles not only benefits by equalizing their action, but by causing an increased flow of blood improves the nutrition and strength of the bones in their vicinity. A blacksmith's apprentice grows up not only with stronger muscles than an office-boy, but with stronger bones. Moreover muscles which are allowed to go by default—to remain for long periods inactive—lose the habit of acting in collaboration and do not easily perform those symmetrical and harmonious movements which constitute grace and which when employed for a useful purpose constitute skill. A sedentary child is likely to grow up ungainly and to be unapt at all pursuits demanding dexterity.

Copy-books, etc. Early writing lessons are often given on slates. They are not to be commended as the writing is often not easily visible and the child crooks its head to get a favourable angle of view. Besides, the fashionable mode of cleansing and erasing by means of saliva (too common to be ignored and too convenient to be put down by edict) must have some (even if inconsiderable) dangers attaching to it. The present writer has no hesitation in saying that the early lessons should be given on the blackboard. This method throws no strain on the eyes, allows the children to move about, to write large, which is easier for their untrained muscles, and permits of the copy being at a distance. The best copy-books are made of paper sufficiently smooth to permit of easy movement of the pen but not glazed or shining so as to throw a glare. They should be ruled with lines easily and distinctly seen, sufficiently wide apart to allow the tails of the long letters to be clear of the tails of the lines above and below. Double lines should be avoided, the effort to keep within their boundaries calls for considerable attention from the eye.

The worst copy-books are those which have the top line occupied with a faint printing of the words to be traced. All varieties of tracing should be rigorously banished. The idea that by tracing, the hand can be trained to the performance of the movements required in either drawing or writing is vicious in the extreme. The maximum of work is thrown on the eye without affording any visual training—indeed the power of appreciating form is weakened. Under no circumstances should it be allowed—neither in copy-books nor in the form of transparent slates. The same may be said of squared sheets and other similar devices popular in many kindergartens.

Copies printed (or written by hand) at the head of the page are less objectionable. But the best plan is to have the copy separately printed on a card and supported on the book-rest, or still better on the blackboard or wall-placard. This leads us to the root of the matter.

METHOD OF TEACHING. The reason why writing is so difficult for children (and even disastrous for some) is that they are brought to the task with insufficient preparation. The recognition of the immaturity of the brain and the eye in the child and the consequent and inevitable want of co-ordination of its muscular movements will at once cause teachers to reject the conventional routine teaching of writing. The waste of energy is apparent once the idea is grasped. The whole question cannot be discussed here but the following simple rules may be relied on to save time and energy.

1. No child should be set to write till it is familiar with the written characters—in other words the education of the eye is the first step and he must know when he puts his hand to the paper what he is going to do. This must be accomplished by the teacher writing first single letters and then words on the blackboard till the pupils are familiar and fluent. Specimens of writing on cards and books should be also used.

2. Children should be practised making single letters on the blackboard, first from copies and afterwards from memory. For example, the letter *a* being selected it should be drawn half-a-dozen times, then the whole rubbed out and the pupil, to the best of his ability (no matter how badly), draw half-a-dozen *a*'s while the recollection is fresh. No child should be permitted to go to the copy-book till he can write all his letters easily on the board.

It must be remembered that young children perform large movements with their hands better than small and the board makes a less call on their nervous energy than the book.

Position of the Copy-book. The Script. The question of slanting or upright writing. The old plan of putting the page to the right hand and sloping the pen with the handle pointing to the ear has happily died out. It is obvious the more the page is put to the right the more tendency there is for the body to twist and the more awkwardly the eyes must follow the point of the pen. To attain straight sitting therefore the mid-position of the book as in reading has been recommended. The further the book is to the right the greater tendency there is to slant the writing, but in the mid-position the writing becomes upright. But the mid-position has certain inconveniences and if rigorously enforced is found awkward by many writers and tends to give a backward slope to the writing—a most objectionable trait—so that a compromise is found advantageous. Remember the object of the position of the book is not a particular kind of writing (that may be left for adults to choose for themselves) but the welfare of the child—so long as the child is straight it does not matter whether the book or the writing is crooked. After many experiments it has been found that the easiest position is a little to the right so that the middle of the page about corresponds to the side of the body and sloped upwards about 20 degrees. The down-strokes are now made nearly vertical

(in relation to the edge of the desk), but when the book is restored to the level position the writing slants to the right. More children seem to write easily in this position and maintain it longer, but the mid-position and the truly vertical writing seems to come easily and naturally to others. Something may be left to individual peculiarities.

SEWING AND OTHER OCCUPATIONS. The foregoing remarks are applicable to sewing, and sundry kindergarten occupations such as pricking patterns, threading beads, making paper mats of coloured strips, &c. In themselves comparatively harmless they are undertaken before the coordination of the muscles has been sufficiently advanced by practice on free and large movements. Empirical reformers have been misled in supposing that the mere change of an occupation from a task to an amusement is sufficient to make it suitable for childhood. Learning to sew in the ordinary manner by rushing at it with untrained faculties is a long and wearisome business, but when undertaken by those who have learned to use their hands it is quickly acquired—so with other fine movements. Nature should be observed and children allowed to perfect the muscular movements in their own way. The idea that the human body and the human mind will not develope without continual jogging from the schoolmaster is a modern and pestilent heresy. First notice what kind of actions a child uses of his own accord and suit the occupation you give him accordingly. Thus you will aid in the conversion of spontaneous action into voluntary movement, which is the end and aim of education. You will find fine movements like those of sewing (and writing) come on later and you lose nothing by following Nature rather than trying to anticipate her. Tasks taken up in their right order are quickly mastered. This to some extent anticipates what has to be said on over-pressure, but it has a practical bearing on successful teaching of routine subjects.

As a preliminary to sewing, NETTING is a very good training. It can be begun large and made smaller in the mesh as handiness improves and there is something to shew at the end. Though apparently some way off sewing (and probably not at first acceptable to the conventional teacher) it will be found excellent in habituating the fingers in dealing with string, twine, wool, thread, and fine silk in succession. While aiding manual dexterity, it need throw little or no work on the eye.

Professional sewing is done with a thread the same colour as the stuff. Even adults complain of this obedience to fashion. Scientific sewing would employ black on white or white on black, and children should be supplied, not with threads which match and are therefore difficult to see but with a good contrast.

LIGHTING IN RELATION TO THE DESKS.

Everything looked at by children should be well illuminated. Blackboards, wall-slates, diagrams, placards, etc., should never be used except when in full light, and this rule must be even more rigidly obeyed in regard to all desk-work—books, slates, copy-books, atlases, etc.—and such occupations as sewing, music and drawing. With a badly arranged light—either insufficient in amount or dazzling from bad direction—children hold their heads close to their books and injure their eyes or twist into awkward attitudes and disturb the growth of their bones. The principle is to throw a full light on to the object viewed and to preserve the eyes from a direct glare. We have then to consider first the *quantity* of light, and secondly *its direction*.

To measure the quantity of light practically, an adult teacher having standard vision should be employed. He should be able to read fluently 20 type at 20 feet (or 6 metres) in any part of the room, and diamond (or brilliant) at 12 inches

minimum distance, the book lying on the desk as it would be used by the pupil. With less light the tendency is to hold the page nearer to the eyes, or still worse to poke the head down to the book and so induce strain of the eyes; besides interfering with respiration. As the conditions of light vary considerably at different seasons and times of day the estimate should be made whenever twilight is approaching. A room that is sufficiently well lighted for reading at noon may be dangerously dark at 3 p.m. In our great northern cities the afternoon light is very bad for at least four months in the year.

WINDOWS. In rooms built for the purpose the windows should have the greatest lateral dimensions consistent with the stability of the building. As the top part of the window is the most valuable it should reach to the roof-plate, and there should be no loss of space from stone tracery (as in pseudo-gothic erections) or stained glass, blinds, or other obstructions. On the other hand the sill should not be too low, 4 ft. is an appropriate height. If the window has been made to reach to 3 feet from the floor (as it may be advantageously in regard to ventilation) it should have the lower panes frosted or deadened by blinds. The blinds should be made to pull up from below as in artists' studios.

THE WALLS AND CIELING. As a great proportion of light is reflected from the cieling it should be white. The *colour* of the *walls* has immense influence. The amount of light reflected depends not so much on the actual colour as on what artists term its "value," *i.e.* its dilution with white. Some tint is advisable to take off the bare bleak look of whitewash, and taste may be allowed to play a part in the choice: pale yellows, blues, greens, or french grey can be obtained from common painters; but some little artistic skill may be required in diluting red or terra-cotta tints to the required brilliancy. The space occupied by blackboards cuts off a good deal of light.

They may be covered by white blinds when not in use, or have the backs painted the wall-colour so that they can be reversed. A very simple arrangement of hinges enables this to be done. A dado of darker tint than the walls or of light polished wood adds to the appearance of comfort without harm.

SURROUNDING BUILDINGS exercise a most pernicious effect. Few board-schools in great cities stand in the space they require either for health or lighting. The width of the street (alas that schools should be surrounded by streets!) and the relative height of the buildings has to be considered. The accepted rule that the street should be twice as wide as its houses are high is to be regarded as the strict minimum. School-boards (for many reasons) should be on the alert to secure open spaces for future use in the outskirts, before unrestricted building makes the price prohibitive, and so acquire the right to regulate the erection of contiguous houses advantageously. Outbuildings, brick walls, etc. may be improved by white-washing. The schoolmaster's rough and ready rule in reference to obstructing buildings is never to place a child for reading or writing where he cannot see a strip of sky. The height of the top of the window must regulate the distance of the desk. In a smoky town experiments shew that there is a point from every window (determined by many conditions) beyond which effective lighting most rapidly diminishes. That point does not greatly exceed the height. For instance, a window 10 feet high gave an effective light to 12 feet along a desk, but beyond that the diminution was remarkable although the room appeared to be well lighted throughout. As a rule desks placed beyond $1\frac{1}{4}$th height of window are to be regarded with suspicion as only being useful under favourable conditions (which are never those to be considered) and the teacher should only allow them to be occupied under reserve. Children should be shifted about and not always occupy the same situation. Those who are seated far from the window

one day should be nearest the next. These remarks apply more particularly to rooms which have not been especially or skilfully constructed with regard to light, but the cautions given should not be neglected even if circumstances seem favourable.

Direction. . In writing the main light should come from the *left* so that the shadow of the hand and pen should be thrown away from the script. But the light ought to be so diffused that the depth of shadow is insignificant.

The light should never come from the front, nor from below as when the sills are too low, as then dazzling is experienced.

Auxiliary lighting. Although the main light must come from the left it is not always possible nor desirable that it should come *only* from that direction. In our dark climate all opportunities of admitting light should be seized, and as the width of school-rooms is determined by other considerations than their suitability for writing, auxiliary windows may advantageously be provided. A kind of clerestory running along the right-hand side or back, with sill at 8 feet from the floor, allows ample space for blackboards beneath and does not contest with the main light from the left.

Tutors and governesses in *private houses* are often disadvantageously placed. Rooms in sunken basements are frequently selected for lessons, but should be declined in favour of a room on an upper floor—the higher the better in town. The desks should be wheeled near to the windows and the precautions above mentioned carefully observed. It is in the preparatory stages of education that much harm is begun, and home arrangements are too often in direct antagonism to the care taken in a well installed school.

Artificial lighting must sometimes be employed though it cannot be commended except by saying that it is sometimes superior to our smoke-obstructed sunlight.

Its drawbacks are feebleness, flicker and glare.

It is generally inefficient. Whatever illuminant is employed there should be plenty of it and a general source of light sufficient to light up the whole room cheerfully and to cause a diffusion capable of counteracting any pronounced shadows which may be cast from desk or side lights.

For this purpose—and indeed for all others—electricity is most convenient as it can be fixed in any position without regard to danger from fire. The general light should proceed from groups of 16-candle lamps fixed immediately below the cieling. In this position with the glass frosted the whole reflecting power of the cieling is utilized without causing any dazzling.

In the case of gas, Wenham burners (or other enclosed lights) can be placed high, or when not easily procurable, as in country places, an excellent light may be arranged by using a ring of horizontal fish-tail burners (as over a billiard table) suspended at about two-thirds the height of the room and having beneath it a concave tin (or silvered) reflector which throws the light well on to the cieling while shading it from the eyes. The village gas-fitter can easily make this and it is very cheap.

The disadvantages of petroleum are so great that it is to be only used when unavoidable. As the rooms in gasless places are generally small a few hanging lamps may serve for general lighting. The lower half of the globes should be frosted.

Whatever source is adopted the books in use are to be immediately illuminated by lights about 15 inches high, carefully shaded by large shades so as to completely screen the readers' eyes from the glare.

FLICKERING is very annoying to the eyes. Gas is the worst offender. Unguarded flames flicker from draughts, and jumping takes place when there is insufficient pressure or water in the pipes. It should be sedulously remedied. There are

many forms of good Argand burners, and the incandescent mantle, which render gas steady; petroleum and electricity burn evenly.

As light to be agreeable ought to be diffused, the *glare* from a bright source such as a naked flame or glowing filament should be carefully shaded from the eyes. Enquiries are often made concerning the irritating qualities of various illuminants and the brighter often supposed to be particularly injurious. This is only the case when the light is placed so as to fall directly on the eyes. When properly shaded the brighter it is the better. Workmen are fond of hanging electric lamps within a few feet of the desk and in front of the writer. During the past few years the origin of much irritation and discomfort has been traced to this arrangement and remedied by the use of shades. No naked light should be permitted in a school-room, either diffusion is to be contrived by ground-glass globes or concentration on the books by means of shades.

Summary.

Desks should be made to fit the children and not children the desks.

The most harmful occupation pursued at desks is writing, and the especial evils curved spine and undeveloped chests.

More turns upon the way a desk is used than on its structural perfection; short lessons at bad desks are likely to be less injurious than long confinement at the most perfect.

The sitting posture is in itself bad and should be directly counteracted by active exercise.

The use of blackboards, &c. for drawing and writing by beginners, in place of copy-books is earnestly advised.

All forms of tracing, drawing by means of squares or dots should be prohibited. Many Kindergarten tasks are very injurious.

For writing the light should be bright and proceed mainly

from the left side and from a level above the desk, but a diffused light is better than one proceeding from a concentrated source.

Auxiliary light therefore may be provided, but it should not be from the front and the window-sills should be considerably higher than those on the left.

A poor light, or one proceeding from the front or below the level of the desk, causes children to assume awkward attitudes and to hold their books too close to the eyes.

Artificial lighting only to be employed when unavoidable. Generally insufficient in quantity. Should be steady, diffused and strictly shaded from the eyes.

CHAPTER XI.

THE AIR PASSAGES.

NOSE, THROAT, AND EARS.

If we look into the open mouth we see that the back part over the root of the tongue is spanned by a fleshy arch having at the highest point of its curve a little pendant about half an inch long, the uvula. All the space in front of the arch is the mouth, all behind it the throat. The archway which is capable of modification in size and shape by muscular action is an opening used for the passage of air and of food. By means of specially constructed mirrors we can examine the cavity above and below. Downwards, behind the root of the tongue, is the windpipe employed in the vital process of admitting air to the lungs. At its upper end is a sounding apparatus, the larynx, which when set in motion produces the voice. Further back is the gullet leading to the stomach, and used for swallowing food. Exploring upwards, we find in front two great orifices, the nostrils, by which we ought to breathe, and behind, on each side, the small internal openings of the ears, the Eustachian tubes. Altogether six tubes, of which one, the gullet, is concerned in the occasional act of swallowing, while the other five are concerned in the passage of air. So that we must consider the throat as a meeting place for the tubes concerned with the management of the air necessary for the health and vitality of the body.

These structures are all continuous, are all liable to be affected for good or ill by the same influences, and a diseased condition arising in one is liable to occur from the same circumstances in another or to spread by continuity.

All are lined by mucous membrane, a softer and more delicate covering than the skin. It is more freely supplied with blood-vessels, more easily damaged by small particles. It is habitually moistened with a thin layer of clear fluid. If irritated, or the blood-vessels become relaxed, this fluid is apt to become excessive, thickened and sticky. It then forms one of the most favourable of soils for the cultivation of any disease-germs that may happen to fall on it. When thoroughly healthy, with only the normal moisture on its surface, free from abrasions, germs have no resting place and cannot congregate and therefore perish from inanition like any other living organisms. The chief aim therefore in preserving the health of the breathing, vocal, and hearing tracts is to keep the mucous membrane in a state of good tone and not unduly moist.

The Nose. The nostrils are seen as two small openings, one on each side of a partition at the lower part of the fleshy projection of the nose. The sides of the openings are not rigidly held apart but tend to approximate rather in the form of chinks than tubes, a remnant of a state of existence when the nostrils could be closed at will to keep out water. Each leads into a large chamber, extending from the roof of the mouth to the base of the brain-pan on a level with the notch between the forehead and the nose. The chamber is divided into secondary passages by thin plates of bone which add enormously to the amount of wall space, as the surfaces of hot-water pipes are sometimes increased by projecting metal plates technically known as "radiators," and the narrow nostrils opening into a large chamber may be compared to Tobin's tube opening into a big entrance hall so as to ventilate without draught. So that when the air is inspired it does

not rush through the nostrils as a draught and pass directly into the windpipe as a cold current, but it mingles with the air already warmed by the surface of the nasal cavity and passes into the lungs at something approaching the temperature of the body. Hence in part the importance of breathing through the nostrils and not through the open mouth.

Young children are especially liable to what is miscalled "cold in the head." The symptoms are familiar. The nostrils are clogged with a thick, yellow, sticky discharge, which cannot be, or is not, blown into the handkerchief, but presents itself as a disagreeable stream dribbling down the upper lip. Among the unwashed a good deal of picking of the nose goes on, and the irritating discharge is carried by the nails and sets up pimples, causes sores and scabs on the skin of the face, among the hair, and may even give rise to inflammation and ulcer of the eyes, not only of the child affected but of his associates.

Care should be taken that children do not "catch" cold, and that colds are cured as speedily as possible, as all "colds," and indeed any form of discharge, is likely to be infectious or contagious.

The great preservation against "cold" is the habitual free exposure of the mucous membrane to clean fresh air. Pure air is not easily found. The air on the ocean and on the higher mountains is absolutely clean, in the country fields and hillsides it may be considered practically pure, but in the narrow streets of towns, dwelling-houses, theatres, churches, and crowded schoolrooms it is unclean, being loaded with dust, dirt, decaying organic matter, and living organisms, all in varying degrees irritating to the mucous membrane. The air of a town playground is not what it should be, but it is better than the air of the occupied schoolroom, and in order to prevent cold-catching children should be sent as frequently as possible out of doors, not only for the purification of

their own air-passages but for the general purification of the air they are to be exposed to during work.

Sudden or violent changes of temperature are dangerous. It is bad to go from a hot room into cold air, it is nearly as bad to do the reverse. Out-of-doors exercise by maintaining the vigour of the surface circulation enables resistance to be made to the paralysing effect of cold on the filaments of the nerves, but a person who has been seated reading or writing in a hot room has his circulation reduced to its lowest ebb and his resistance minimized; if he goes straight from his desk to the cold air he is easily chilled before he has time to start a vigorous heart's action. Therefore it is well when the outside temperature is low or there is a keen wind blowing to put the children through a few minutes' specially vigorous and rapid exercise before turning them out.

On the other hand, when the terminal nerves are enfeebled by cold and they have lost their control of the fine blood-vessels, a sudden rise of temperature causes a rapid relaxation and outpouring of an excess of surfacc fluid. The inbreathing of germs or irritants always present in the air of crowded rooms completes the business and a cold is established. It is therefore right to open the windows and thoroughly ventilate the room while the children are out so as to blow away the germs and impurities of occupation, and to have the means of raising the temperature to the required degree at will, but not to have too great a contrast when they enter. As the circulation quietens down the temperature should rise. There should be no pedantry in the matter and no blind following of the thermometer nor routine adherence to fixed seasons. Judgment founded on experience and observation must be exercised. As a general rule a room should feel fresh on entering it, there should be no sniff of previous occupation, there should be a pleasant sensation of shelter and comfort but not of heat, there should be no feeling of chilliness or coldness of the hands or feet after sitting. The

greatest difficulties arise from East wind or fog, the two atmospheric conditions most fatal to young children. The former lowers vitality to an extent incommensurate with the mere lowness of the temperature, and the latter renders ventilation by the open window impossible. With a well-arranged playing shed a good deal of useful exercise can be managed away from the wind. Active combative games where there is no standing about may be allowed, but expedients should be devised to prevent dawdling or standing still. Fog is the one condition when young children should be kept indoors.

Draughts are fatal—no child should be allowed to sit in a draught, and the currents of air from open windows or ventilators (which have a trick of working the wrong way) should be jealously watched.

As "cold in the head" is the result of a general chill and not merely of the nose, parents should be instructed to clothe their children safely and rationally. The question of rational clothing may be dismissed in a sentence. It should be loose and it should be woollen. Arrangements should be made in all schools for a change into dry shoes and stockings in wet weather.

A sharp look-out should be kept for growths impeding breathing by the nostrils. Two kinds are frequent, (1) Enlarged tonsils, familiarly known and visible through the opened mouth; (2) Small fleshy growths, occurring behind the veil of the palate, invisible except by the aid of special apparatus, and known as "adenoids." Both kinds frequently exist together and may be recognised by the following symptoms, which are generally obvious to any teacher who has established a good ideal of sound health.

Breathing through the nostrils is impaired and the nose acquires a pinched look, the mouth is habitually kept open, giving an expression of stupidity, the voice is thick or hoarse, the nasal resonance is impaired, so that m's and n's are badly pronounced and replaced by b's and d's, there is a good deal

of dribbling from the nose, and hawking of phlegm and general symptoms of persistent "cold in the head." Headache and malaise are common. Breathing is an exertion and the lungs are imperfectly filled so that affected children are shortwinded and do not like running games.

Among the grave consequences of the defects here alluded to are (*a*) An imperfectly expanded and therefore ill-developed chest; (*b*) insufficient aëration of the blood, with its further result—ill-nutrition of the brain, and impaired digestion; (*c*) deafness.

These cases require surgical treatment. But the teacher has peculiar opportunities of detecting the symptoms, in thick utterance, persistent nose-discharges, and so on, and it is his duty to notify parents of the source of the mischief. A considerable percentage of town children suffer in this way.

Common sore-throats are popularly ascribed to cold, but though chill as aforesaid undoubtedly acts as the predisposing cause, the real and effective cause is the inhalation of irritants or impurities. The liability to sore-throats therefore may be temporarily increased by a chill or it may exist as a permanent condition owing to a natural delicacy of the mucous membrane, or a constitutional defect such as rheumatism. In many cases it is not possible to trace the noxious influence giving rise to the attack, but recurrent sore-throats in children should at once arouse suspicion of drains and the condition of the home should be investigated. The victims of enlarged tonsils are more susceptible than others, a great variety of germs finding in them a congenial habitat.

Even tubercle, the active factor of consumption, may through the tonsils find its first establishment in the body and spread to other parts. The swollen neck glands so commonly seen are frequently tuberculous in character and have been absorbed from the throat.

Acute inflammatory attacks, quinsy, the onset of scarlatina or measles, diphtheria, need not be here considered, as children suffering from these complaints are not likely to be sent to school. But the rule should be to deny admission to any child suffering from any form of sore-throat, as there is no predicting whether or not it may become infectious. On this head a medical opinion must be sought.

The Care of the Ears.

The ear in relation to the physiology of hearing is a very complicated organ, but in regard to hygiene it is simplicity itself. Unlike the eye it is not directly affected by school-life, but its hygiene is nearly identical with that of the throat and nose, in which originate most of the diseases affecting its function. In order that the waves of sound may reach the nerve-structures that constitute the essential organ of hearing a tube passes obliquely downwards from the side of the head to the throat. This air-tube is not a mere hollow pipe but differs in structure in three portions of its course. At first it can be seen, leading from the lobe of the ear, as an open tube called the meatus or outer ear. About its middle it expands into a small irregular chamber called the drum. Between the drum and the throat extends a narrow passage called the Eustachian tube. This, unlike the outer meatus, is not an open tube, but the sides are in apposition except during the act of swallowing when they open and permit the air in the throat and the drum to communicate. The meatus is lined with skin and is consequently liable to the ordinary diseases attacking the skin, such as boils and eczema. The drum and Eustachian tube are lined with mucous membrane and are liable to the affections proper to that tract.

Between the meatus and drum is stretched the drum-membrane, a thin transparent structure capable of being set into vibration by the impact of sound-waves, as the parchment

of a soldier's drum responds to the tap of the stick. The vibrations are conveyed to the sound-perceiving apparatus by three small bones acting as levers, and resembling the levers between the keys and strings of a pianoforte.

The foregoing sketch enables us to understand that deafness may be caused by anything that impairs the free vibration of the drum-head, thickening of the membrane itself, stiffness in the joints of the bones, fluid in the drum or stoppage of the Eustachian tube.

There are no precise tests of hearing adapted for popular use. The tick of a watch and the human voice, though both vary enormously, are the only two tests generally available to teachers.

To use the watch as a standard. The same watch must be used in all trials. Ascertain the distance at which the tick of your watch can be heard by taking a number of persons of presumed good hearing. The furthest distance the tick can be heard definitely is the standard for that watch. The watch must be held suspended by its handle or chain on a level with the ear and the person under examination must not look at it. The test should be begun by holding the watch beyond its known distance and gradually approaching the ear till the tick is definitely heard. The distance for an ordinary hunter will probably be found to be about four feet. Any marked failure should be notified to parents.

The carrying power of the teacher's voice should be ascertained for teaching purposes as well as for ascertaining the deafness of children. The pupil should be stationed at a definite distance, say 20 feet, with his back towards the speaker so that the movements of the lips are not seen. Then phrases should be uttered in the ordinary speaking voice, and if not heard the speaker should advance step by step till unfamiliar and out of the way words are distinctly heard. The average distance being ascertained any marked failure is easily noted.

If the voice does not carry to the distance at which the most distant members of the class are usually seated the vocal instruction may be regarded as ineffective. If particular members of the class fail to hear phrases audible to the majority, they may be assumed to be more or less deaf and should be referred for expert opinion.

No noise made in a school injuriously affects the ear. Oral instruction may be continued indefinitely without inflicting the slightest injury on the hearing. The diseases requiring care on the part of the teacher can be anticipated as they arise in the nose and throat and be recognized before they reach the ear. Two conditions are however to be noted.

Ear-ache attacks young children with great frequency and severity during their second dentition. It will arise from draughts on the side of the head or more frequently from a general chill, cold feet or too abrupt change of temperature. The pain is often severe and distressing, but if the patient is kept quiet and in an even temperature it often passes quickly away, leaving no ill effects.

Discharges from the ear are frequent consequences of infectious disorders, scarlatina, measles, whooping-cough. Sometimes they are thin and glairy, more often they are ordinary yellow "matter," sometimes streaked with blood and sometimes smelling offensively. Whatever the degree of severity, they are disgusting in appearance and give rise to a certain amount of deafness. A superstition exists that they should not be stopped. No more mischievous doctrine has ever been accepted. The purulent disease is at first confined to the mucous membrane —where it is comparatively harmless—but it spreads to the innumerable cavities that communicate with the ear, causes inflammation and the death of the thin bony plates that separate the ear from the brain. Finally, the membranes of the brain are attacked, giving rise to purulent inflammation and abscess of the brain—from which ensues death.

Every untreated discharge from the ear is a potential cause

of death from brain disease. It ought therefore under no circumstance to be overlooked by the teacher.

The drum membrane is likely to be ruptured by concussion. One common cause is the rush of water into the meatus in plunging. As a rule water does not enter the ear forcibly as the air acts as a cushion as it does in a diving-bell, and thoroughly healthy ears stand a good deal. But when there has been frequent inflammation or ear-ache there is danger, plunging should be indulged in with moderation and wool worn in the ears while bathing. The other cause is boxing the ears, a time-honoured punishment that no self-respecting teacher would now inflict in the present state of our knowledge of injuries reported.

The Care of the Voice.

The larynx (or Adam's apple) is a triangular chamber of hard gristle with the apex forward and the base behind. Its shape can be felt from the outside. It forms the frame by which the breathing aperture is kept open and supports the vocal chords by which the voice is produced. The vocal chords are not chords, but folds of membrane attached by broad bases to the inside of the larynx, but having sharp edges projecting into the air passage. When at rest the opening is triangular with the apex forward. In this state the air passes to and fro without sound. By the exertion of muscles the chords can be tightened and the chink between them narrowed. Then if the air is expired with more or less force its passage causes a vibration which gives rise to the voice. The sound varies in loudness according to the force of the expiration and the note varies from low to high (in the same individual) according as the chords are loosely or tightly drawn. The mechanism so far is comparable to an Æolian

harp. When the sounds are modified by movements of the tongue, teeth, and lips articulate speech is accomplished.

The only points needing attention from teachers are, that the higher the note the greater the muscular exertion, and that the quality of the voice—that is to say its clearness, huskiness etc.—is affected by the healthy or unhealthy condition of the whole mucous tract lining the nose, throat etc. and not only by the state of the larynx.

The voice is not directly harmed by school work. Indeed as quiet is a necessary condition for literary study the voice in school suffers rather from want of development than over exercise.

But, even for the sake of health, children should be encouraged to "speak up" and to articulate clearly. Every muscle in the body is intended to be exercised and the perfect command of every faculty should be the aim of education. By the habitual exercise of the muscles of speech from youth upwards the full strength and mobility of the throat can be attained and public and sustained speaking rendered easy and harmless. Clergyman's sore-throat is frequently due (at all events in part) to the attempt made to speak very carefully in the pulpit by persons who have indulged in a lifelong slovenly articulation, so that an entirely new set and combination of muscles are called upon in church from those used in ordinary life. Hence the symptoms of strain which might be avoided by judicious training from the beginning.

Children therefore should be encouraged to articulate clearly in class. Shyness and timidity must be overcome. Mumbling, low speech, with teeth closed and half-opened lips, means imperfect inspiration and a perpetuation of that bad aëration of the lungs that is one of the banes of school-life.

As a means to a clear and easy articulation the mode of inspiration must be watched. Singers and speakers who

breathe by using their abdominal muscles do better than those who merely raise the chest walls. In just the same way the teacher's voice is more effective and has far better staying power if it is used in accord with the plain laws of breathing and articulation. In dealing with children, care should be taken that nothing exists that interferes with the movement of the abdomen. Tight lacing (not unknown even among young girls), tight belts or trousers-bands, overloading of the stomach with food (no good singer will sing directly after a full meal), flatulence, are all impediments to proper voice production. The teacher should especially notice the movements of the collar-bones during recitation or singing, and if there is over-action he may safely infer something injurious in the conditions of the dress round the waist. Bearing in mind that the production of high notes throws the most work on the vocal chords, the teacher of singing will be careful to keep a child well within its upper register. Tunes and exercises that can be taken easily are wholly beneficial. Regular practice in school and all that may encourage it outside are to be strongly advocated.

A very remarkable change takes place in the vocal organs as puberty is reached. The larynx rapidly enlarges and the voice correspondingly increases in volume and power. During the time occupied in this change systematic exercise of the voice should be interrupted. This does not imply that all singing should be forbidden, as easy tunes, such as hymns in church, and occasional songs of a small compass, are harmless. The changes occur in girls from twelve to thirteen and in boys on an average some two or three years later. The change is more troublesome in boys than girls, and of course the permanent alteration considerably greater.

SUMMARY.

1. The nose, throat and ear are portions of one tract and diseases occurring in one part are likely to occur from the same causes in another or from continuity.

2. The health of the tract is promoted by habitual free exposure to pure air; susceptibility to disease is fostered by indoor life and coddling.

3. "Cold in the head" is due to the inhalation of irritants or poisonous germs over a mucous membrane weakened by a chill or other debilitating causes. The bad air of an ill-ventilated room is often the immediate cause of cold.

4. Remains of a cold at the back of the nostrils is frequently the starting point of disease of the ears and other parts of the throat.

5. Enlarged tonsils and adenoids, by impairing breathing, disastrously hinder the development of the chest besides interfering with the hearing and the voice. Enlarged tonsils may form starting points for the absorption of infections and even of tuberculosis.

6. The ear does not suffer from over-pressure in school-life. Its hygiene is the hygiene of the throat.

7. A discharge from the ear should be sedulously treated. It is often a cause of death.

8. The larynx is not sufficiently exercised in schools. The voice should be developed by clear utterance in class, elocution and singing. Shouting at games is the fulfilment of Nature's instinct and should not be stopped.

CHAPTER XII.

EXERCISE.

1. *General considerations.* The chief use of exercise is to vivify and purify the blood. The function of the blood, roughly stated, is the conveyance of two things to the tissues, oxygen and food. Oxygen is the prime vital necessity. A man can live some days without food, but deprived of oxygen dies in a few minutes.

Life is a process of combustion maintained by the oxygen of the air exactly in the same manner as a fire burns in a grate. If the air is blown through the fire by the bellows the fire burns briskly, the carbon of the coal combines with the oxygen to form carbonic acid which escapes by the chimney. Smoke is unconsumed carbon; with a bad draught the more smoke and the more ashes and cinders to clog the grate; with no draught the fire goes out, though the grate may be full of fuel. By an economical arrangement, common in Nature, the lungs are both the bellows for the supply of oxygen and the chimney for the removal of carbonic acid. Inspiration is the act of supplying oxygen, expiration of removing carbonic acid (and other products). Air which has been once breathed is stated to have lost 5 per cent. oxygen and gained 5 per cent. carbonic acid. The amount of carbonic acid exhaled by an adult in 24 hours represents about 8 ounces solid charcoal.

The lungs consist of two bags, with their inner surfaces enormously extended by subdivision of the bronchial tubes. On these surfaces is spread a network of tubes called, from their hairlike fineness, capillaries, which convey the blood. The walls of these tubes are excessively thin so that gases pass easily through them. The blood is pumped into the lungs about 70 times a minute. Air to meet it is inhaled about 20 times a minute. The blood as it enters the lungs is loaded with carbonic acid and crimson in colour; when it leaves the lungs, after exposure to the air to return to the heart, it is relieved of carbonic acid, supplied with oxygen and scarlet in colour.

Carbonized blood is a poison to the brain and nervous system. French suicides effect their object by breathing the carbonic acid supplied by burning charcoal. Partially carbonized and therefore partially poisonous blood is provided by detention in school-rooms and other places of assembly. No system of ventilation yet discovered will render the air indoors as vitalizing as the open.

The diseases of sedentary life (well recognized in middle age) are the result of suboxidation. School-life in so far as it relates to study is sedentary and tends to suboxidation, in so far as it relates to games tends towards perfect oxidation and health.

Other impurities are due to food and products of the wearing out of the bodily structures.

Food when digested is conveyed by a slender duct and dribbled into the great vein and thence distributed by the heart to the remotest parts of the body. If diet were exactly proportioned to the body-waste it would be all absorbed, but no perfect food exists and therefore a surplus remains in the circulation. In people who eat too much or with bad judgement, the surplus constitutes a source of disease.

The various structures—muscles, brain, liver and other organs continually absorb the food necessary for their life

and work and cast out into the blood their waste products. In good health with a vigorous circulation and respiration a thorough combustion is maintained and the waste products are readily eliminated, but with sluggish combustion all kinds of intermediate products are formed, many of which are poisonous and with great difficulty removed.

The first and obvious effect of exercise is to quicken and deepen respiration—in other words to supply more oxygen. Taking the inhalation while lying down as 1, walking at three miles an hour rather more than trebles it, riding and swimming more than quadruples it. The advantage of gentle exercise is therefore apparent.

The second effect is quickening and equalizing the circulation. When a man sits at an intellectual task—as writing—there is an increased flow of blood by attraction in the brain, where for the time it is wanted, and there is an accumulation by gravitation to the lower part of the abdomen, where it is not wanted, and where it does harm. But when the heart's action is improved by exercise, local congestions disappear and the blood is equably distributed.

Third, it promotes the strength and growth of muscles, and it is well known that the whole body may be rendered bigger and stronger, or that certain groups of muscles may be especially trained. The apostles of culture affect to depreciate muscular strength, but when it is remarked that the HEART is nothing more nor less than a muscle—albeit it is the most important in the body—and that the stomach is a muscular organ, we are compelled to admit that the muscular development is of the utmost importance. It may be a matter of indifference whether we start a boy in life with a strong or weak biceps, but it must be a matter of earnest endeavour to start him with a sound heart.

Muscles are arranged in three groups: (1) those wholly under control of the will, like the muscles of the limbs; (2) those partially under control, like those of respiration.

Ordinary breathing is an involuntary act, but we can breathe deeper or quicker as we wish; (3) those entirely beyond control, as the heart and in the intestines.

The skin is commonly regarded as a covering added to the body for the sake of beauty and protection (for which we have substituted clothes) but it is in reality an organ of respiration of great importance. Like the lungs (though to a less extent) it absorbs oxygen and exhales carbonic acid, but its chief property is the removal of water holding salts in solution. Under ordinary circumstances no liquid appears on the skin but the water exudes in a state of minute subdivision termed *invisible perspiration.* Under the effects of heat, exercise, or emotion, the whole surface may be bathed in sweat. Two or three pounds weight may be lost by manual labour on a hot day, and considerably more has been observed as the effect of a single Turkish bath. In the interior of the body the kidneys perform a nearly similar function of removing vitiated water. The organs are to some extent compensatory. When the skin is active the kidneys are relieved, but if perspiration is hindered they are forced into extra work, which in the case of a chill may be so excessive as to cause disease. The beneficial effects of a moderate daily sensible perspiration is doubted by none. The danger of chill from excessive perspiration arises from the rapid cooling of the surface by the conduction and evaporation of the moisture, the conditions are exactly the same as in stepping out of a bath and allowing ourselves to dry without using a towel, contact of saturated cotton clothes instead of appropriate porous and absorbent woollen material, and exhaustion of the nervous system from over-exertion or want of food. It is not perspiring which causes the chill, but the avoidable circumstances which accompany it.

SCHOOL-EXERCISES are to be divided into two classes, *Disciplinary* and *Recreative.* The first fit the body for useful work and sports by training the muscular system (including

of course the nerves) in a regular manner capable of graduation to the strength or requirements of the individual. They ought to be as carefully studied and administered as any literary rudiments. Walking, running, rowing, swimming and climbing (or gymnastics) should be habitually practised under superintendence so as to avoid slovenly work and get the best that can be got out of the material. It should not be left to chance whether a boy walks or lounges. He should be taught to walk straight, and made to walk regularly. It should not be left to chance whether a boy flounders or swims. He should be taught to swim and practise regularly till he can swim with style and strength.

Recreative exercises or games are quite indispensable on account of the mental enjoyment and excitement they afford. The exercise is more haphazard and cannot be graduated and arranged so as to train for endurance or for the exercise of a particular set of muscles. If a boy is sent for a four-mile walk we know how many steps he will take and the time he will occupy, if he goes to the wicket he may stay there for an hour and get plenty of exercise, or he may go out first ball and loaf the whole afternoon.

Walking.

Walking necessarily forms a great part of everybody's exercise. Without doubt children might be kept in good health by games alone, but concentration on their trivial details would tend seriously to narrow the mental outlook and to this walking, with its change of scene and varied incident, is the natural corrective. Moreover wet and stormy days unfit for games can be profitably employed in brisk walks. In fine weather a country ramble affords great pleasure to children. They take a keen delight in hunting for small animals, birds' nesting, butterfly collecting, mushroom gathering, and so forth. Thus many a man has laid the foundation

of observation and classification. Fatigue may be avoided by a few simple precautions. Children must not be hurried nor put to keep step with longer-legged comrades, they must be allowed plenty of rests and frequent snacks. The high-road should be avoided and a route over fields or common with a varied surface should be chosen. It is not the distance traversed, but the time occupied in open air exercise that does good.

When no sports are afoot a short brisk walk should form part of school-life. Great liberty of action should be allowed. The "Crocodile" of ladies' schools is depressing to the spirits and inefficient as exercise.

The ill effects of walking are but few. In both sexes the rapid growth of the long bones at puberty changes the centre of gravity and the leverage of muscles and is apt to bring out latent defects. Girls are especially liable to a "turning in" of the ankle, which if not corrected may persist, others knock the feet or ankles together as they step.

Flat-foot is due to weakness of the muscles and ligaments for which heredity may be to some extent responsible. But children who are kept at the desk, when Nature requires them to be running about, increase in weight without acquiring a corresponding increase in the strength of the legs, and thus the arch of the foot becomes unable to bear its burden. The untoward effect is much hastened by continuous walking on *pavement*, which has a most disastrous effect on all feet—young or old. These distressing and disabling affections are seldom seen among the dwellers in hilly country and it may therefore be taken as a good working rule that the strength of the lower limbs should be cultivated by free exercise over soft uneven ground, before the weight of the body begins to tell.

Badly made shoes. The shoemaker has so thoroughly adopted the advice to stick to his last, that he has almost forgotten the shape of the foot. Specific instructions on shoe-making are beyond our scope. But it may be pointed out

that the shape of the foot in action differs considerably from that at rest, so that a shoe that fits in the shop may be injurious in a long walk. The inner side is nearly straight and the great toe does not turn out at an angle, therefore the inner side of shoes should be straight also, and not curved like the shoulder of a coffin.

If the transverse arch of the foot is compressed the joint between the third and fourth toe is loosened, and a painful neuralgia (mistaken for rheumatism) is established. A thick and rigid sole with tight laced ankles (plough-boy fashion) prevents bending of the foot and leads to a slouch of the whole body. However thick the sole the waist should be supple and the upper leather should permit free ankle play.

A good shoe fits the hinder part of the foot snugly, and allows free play to the fore part, it holds the foot by fitting and not by compression. Sandals are now made for children, and are good.

Running.

Running, the foundation of most active games, is (rightly) carefully cultivated at our great public schools and (wrongly) neglected at those of an inferior grade. I fail to see any reason for the difference, as vigorous health is as necessary to the poor man's son as to the rich. No other exercise has so good an effect on the respiration and circulation. By no other (in the time) can the impure air of the schoolroom be so completely pumped out of the lungs and replaced by the pure outdoor air. The only supervision necessary is to see that children are not forced to run beyond their strength either in pace or distance. Systematic practice in running makes games pleasurable and profitable. Disinclination for games often springs from feeling "not fit," easily getting out of breath, "stitch in the side" and other grievances of the child who has been coddled or allowed to loaf. The calls

made by games are intermittent, but very sudden and exacting and require good previous preparation if they are to be met with any degree of enjoyment.

Runners should be carefully observed to discover awkward movements, and pains should be taken to ascertain their origin. Bodily deformities are sometimes responsible, at others shoes. Insistence on good style has a good influence in promoting symmetrical growth.

Young boys and girls run with equal ease, but from adolescence onwards in consequence of a difference in configuration a marked change in favour of the boys is seen, and the training of the two sexes rather differs. As a rule girls are altogether neglected. This is wrong, for although not so well adapted for long runs, they benefit fully as much as boys by being exercised up to a lower standard.

Three descriptions of runs may be commended, as generally useful: (1) Short run at a moderate pace—especially useful as a lung cleanser and dispeller of the fidgets in the breaks. Schoolmasters are by no means alive to the value of breaks—they give too few and do not utilize them. A man who from long literary training has become endued with an artificial patience (as we all are in our own particular form of drudgery) can scarcely realize the tedium and weariness suffered by the young and unaccustomed sitting over books, the awful languor of the brain with a circulation nearly down to sleeping point. A short run of a few hundred yards will often revive a class that seems hopelessly stupid and inattentive.

(2) The race run at full speed over a measured course with the precautions of either grouping the runners or a handicap.

(3) The long run into the country. This may be taken over a given distance chosen for its surface, and the pace a "go as you please." Town schools may advantageously take a little lift by train out of the smoke. Public school boys cover 8 to 12 miles as "a grind" with benefit. Only a small

percentage of town lads are fit for so long a course but steady practice does wonders even for the most unpromising. As a variation the paper-chase with the added interest of a little sport is very popular.

Running is more easily overdone than any exercise and requires watching. Common sense is alone needed to form a judgment. After a run within the strength the runner comes in fresh, with a heightened colour, breathing perhaps difficult, but recovering rapidly on rest, thirsty and hungry and ready for food directly cooling is finished. The exhausted runner is pale or grey, skin covered with a cold perspiration, attention perhaps wandering or actually stupid, no disposition to undress or change clothes, faint or dizzy, no disposition to take food but often sick or nauseated if the attempt is made to eat or drink. Appearance drowsy but sleep either impossible or accompanied by dreams and twitches.

ROWING is one of the healthiest sports for boys or girls and its acquirement is valuable as it can be continued (with judicious slowing down) till an advanced age. Nearly every muscle is called into play, but those of the back are especially strengthened. It is therefore beneficial to girls who are liable to suffer from weakness of these muscles in consequence of the combined effects of the sitting-posture and the unnatural habit of wearing stays.

No more force need be expended in rowing than in walking a given distance, but more stress is thrown on heart and lungs. The drawbacks to the wide adoption of rowing are want of suitable water and the expense of hiring or purchasing boats, but as the exercise does a great part of the work of the gymnasium in a healthier way it should not be lightly set aside.

Over-exertion usually occurs in racing or when an untrained boy is sent to row with others in good practice, and is forced to continue pulling when he requires an easy.

Rupture occurs—it is greatly promoted by tight belt round the abdomen—Trousers should be made sailor-fashion tight round the hips. Girls should be forbidden to row in stays.

Precautions. Do not row after a full meal, till in good training pull a slow stroke and take plenty of easies, do not choose too light a boat, a moderately heavy craft gets more way on. Keep the mouth open during the pull, take breath during the return.

The *special danger* of rowing is drowning. Therefore, learn to swim and save life. Do not stand up in the boat, never change places without rowing to shore, if an oar is dropped overboard row close to it, one only of the crew is to be deputed to put his hand out to seize it and that without leaning over—better make half-a-dozen attempts than upset. If thrown out of a boat keep calm, unless near shore swim towards the boat, seize it if possible near the stern so as not to disturb its trim, do not on any account attempt to mount into the boat but let the rowers make for the shore. A drill for practice in shallow water of the management of an upset boat and above-named accidents has been found very interesting to boys and is of course sufficiently useful to be worthy of close attention for teachers.

SWIMMING.

An art so valuable that its neglect amounts almost to a crime. Every child, male or female, should be taught to swim, as occasions may arise when the power of swimming or of merely remaining calm in the water may mean the difference between life and death.

Its neglect is partly due to the assumption that a large quantity of water is necessary for teaching. On the contrary a large bath is a positive drawback, as young children are frightened at the immensity, noise and strangeness of our

public baths. An adult can, at a pinch, be taught in a bath 12 ft. × 6 ft. with the water breast-high, and children in one of proportionally smaller dimensions. The maintenance of such a bath is probably not beyond the means of most schools within reach of an urban water supply.

The entrance to the learners' bath should be a gentle slope with a good hand-rail. Every precaution should be taken against alarm and fright combated by demonstrating the safety of every step taken. Support and aid should be freely given and only gradually withdrawn, no tricks should be allowed, disturbing and alarming noises forbidden, and the water warmed (70 to 75 F.).

The great value of swimming lies not alone in its exercising all the limbs, but in its training the respiratory muscles, as a right economy in the taking and husbanding the breath is part of the art. The body lies nearly horizontally in the water, with the weight removed from the spinal column, and the equal movements of the trunk-muscles have a great effect in counteracting the evils of the writing-posture. Mothers who desire symmetrical figures for their daughters should arrange for them to swim frequently. Few exercises have a more marked influence in straightening the back.

Harm is chiefly due to staying too long in the water. Boys are especially prone to dawdle half in and half out of the water till they shiver, and their extremities are "dead." In very hot weather two or three bathes may be taken in the day with advantage, and as a rule two short dips are healthier than one long immersion. Muscular exhaustion may result from a miscalculation of distance in swimming out from shore or from being caught in a current, or buffeted by rough waves. Hence boys should not be allowed to swim out in deep water (rivers or the sea) without an accompanying boat to pick them up when fatigued.

DIVING into shallow water from a height is dangerous to the unpractised. Fractures of the skull, dislocations and other

serious and even fatal accidents have been known to occur. Too much care cannot be expended in teaching diving thoroughly. It affords the keenest enjoyment to the young, and is not more dangerous than any ordinary form of gymnastic exercise.

Ears which have suffered from disease are liable to be injured by the rush of water, causing giddiness, inflammation, or deafness. In healthy ears the air-pressure generally keeps out the water after the manner of a diving-bell. Those suffering from delicate ears should wear pledgets of wool when diving. Cases of drowning supposed to be due to cramp are now generally considered to be often due to ear-mischief causing giddiness.

PRECAUTIONS. Bathing should not be allowed sooner than about two hours after a full meal. The results of neglect are vomiting, headache, flatulence and indigestion. Nor when overheated or exhausted from violent exertion; but it is better to be a little too hot than a little too cold, so that it is important to forbid dawdling about on the bank after undressing. The strong may bathe before breakfast but for delicate children noon or afternoon is better.

Rheumatic children and those having fits should have medical sanction before bathing. Each case must be judged on its merits.

Exercises in SAVING LIFE afford a good deal of fun, and have a practical value. Systematic instruction should be given when swimming is mastered. The first step is to practise in clothes, the second to learn how to approach the victim without incurring peril. Boys told off to represent the drowning man usually enter into the spirit of the thing, and embarrass their saviours in a sufficiently realistic manner.

The Royal Humane Society offers a prize to schools for proficiency in life-saving practised under conditions.

Cycling.

Cycling has had a remarkable effect on the health of adults, and might be expected to take a prominent place in school exercises. But it may be dismissed from consideration except as a means of locomotion. It enables town children to get out easily into the country—no small matter—and numbers now ride to and from school, with the distinct advantage of keeping their feet off the pavement. The young learn easily and ride with surprisingly little exertion, so that a machine may be regarded as a great source of pleasure not likely to do much harm unless adopted as a substitute for more varied exercises. Accidents of course will occur, as they must with any thing on wheels, but they are generally due to traffic, or to riding down hill without a proper brake.

Games.

Games are regarded by children as pleasures, but by the wise teacher as the attraction whereby the regular open-air exercise essential for growth and health may be secured. Therefore they are to be regarded seriously.

School games are for the most part varied exercises in walking and running, with the added use of the arms in throwing and hitting the ball. The trunk-muscles are continually called upon to perform rapid and varied movements in maintaining the balance of the body. Regular play at cricket, football, hockey, with the practice necessary to acquire proficiency may be counted on to exercise every muscle in the body in a pleasurable manner without fatigue. The various gymnastic "systems" which are the delight of certain arm-chair pedants, may be dismissed as fitted for valetudinarians rather than children. Occasionally for the sickly and deformed "movement cures" have undoubtedly great value, but the

healthy need none of them. Our national character has not been formed by waving our limbs about and pulling at ropes in dreary obedience to the directions of a manual, but in contests, struggles, and emulation on the field, the river and the moor.

Games and sports are the amusements of the Englishman and they are answerable for his mental qualities and his muscles. Hence the unwritten law of our public schools that makes games compulsory is a good law.

Unfortunately the law of the land has made detention in a schoolroom compulsory, but has not touched on the subject of healthful exercise.

Cricket is the king of summer games. It is permanently interesting, keeps the players out in the open for hours on the turf, and provides the most varied movement, besides (in common with other games) providing lessons in temper, self-restraint, and educating the hand and eye to act in concert.

Girls become keen cricketers, and though they seldom excel (indeed falling off as they approach womanhood) they nevertheless derive enjoyment and health. In the better class girls' schools it is encouraged, but like other things connected with physical health, a good deal neglected in others.

Football is a good muscle-forming combative game which does more to promote strength than any other. Objections have been urged on the score of danger, but among boys it is really remarkably free from accidents. Its popular reputation is largely due to the comic papers and not to observation of facts. Boys require to be classified so that the youngsters are not overweighted. With that precaution it should be played throughout the school. It is wholly unfitted for girls.

Hockey, an admirable fast game, necessitating much turning about and change of attitude beneficial to the trunk-muscles. It requires less strength than football, but keeps the breathing in full work. It has the advantage of being playable all through the winter, and on all sorts of ground, turf, the

sands, or ice. It is the source of many small accidents and many bruises, unless sticks and sides are carefully watched. No game seems to have so marked and immediate effect on the health of girls. They play with keenness and ability, and many continue to play after they leave school.

The foregoing exercises suffice to maintain a good standard of health but do not fully develop the arms and chest.

The GYMNASIUM though apparently artificial, really satisfies an instinctive need of climbing felt by the young. Children left to themselves invariably climb. Boys perch themselves in the branches of trees to read, and play on the tops of walls, roofs, and other positions that offer nothing but terrors to adults. Ladders, ropes and bars, are no substitute for outdoor exercise, but have an important influence on development. Injudiciously pressed they have a tendency to overdevelop the upper parts. The pupils of professional strong men are almost always top-heavy.

The ordinary gymnastic exercises are well adapted for their purpose, and only need caution in keeping well within the strength of beginners and the untrained. It is not by attempting feats beyond the powers that the body is strengthened, but *by the reiterated performance of* easy tasks. The fancy tricks of the gymnasium are unsuited to girls, but a selection is easily made. A word in favour of the trapeze may be said. It is greatly neglected, but girls find it exhilarating, and it has a most excellent effect in training shapely arms and shoulders. Female gymnasts who excel in this exercise are said to have exceptionally good health, and not to suffer in any special way.

No one would neglect dumb-bells, bar-bells, and Indian clubs—used when possible to musical accompaniment.

For girls fencing should form a part of winter exercise—there is no substitute for it, and it is rightly becoming popular.

For boys single-stick and boxing are more congenial, and should be practised.

The wise teacher will encourage a variety in games, by example, rather than by compulsion. Children are imitative and follow the fashion, which changes frequently, with advantage, as all games have their weak and strong points and are often mutually corrective. The chief care should be to see that play is vigorously practised, that the bookworm is brought into the open air, the loafer stirred into activity, and that no excuse in the way of work or indoor entertainment should be allowed to interfere.

CHAPTER XIII.

OVER-PRESSURE AND THE GENERAL MANAGEMENT OF HEALTH AND DEVELOPMENT IN RELATION TO EDUCATION.

OVER-PRESSURE is a term that has been adopted of late years to describe condition of failing health seen in school-children. It is especially applied to cases of nervous breakdown supposed to result from excessive intellectual work, but this application though containing a part of the truth contains only a part. Its acceptance, which may be said to be general, indicates a curious wrong view of the purposes and functions of the teacher. Pressure, provided it be not too heavy, seems to be admitted as an allowable condition in education and only dangerous and condemnable when "over" or beyond what is bearable by the pupil.

But for a right understanding of the question all ideas of pressure must be put aside. Education means expansion and not pressure, it means leading or drawing out and not pushing in. A child is not to be forced but to be led, not to be hurried but judiciously restrained, not to be taken out of the hands of Nature but to be protected from the artificial evils of modern life, not to be moulded or squeezed into the particular shape that happens to be fashionable at the hour, but to have the faculties of body and mind that happen to be his personal endowment encouraged and developed to the utmost fulness of their capacity.

A rational system of education would provide for the improvement and not permit even the temporary impairment of the child. Slowly it may be, but surely, bodily strength and mental ability should increase. The muscles, the nerves, the internal organs, the senses should all improve. At the end of a term all the children should be better—in every respect—than they were at the beginning. The holidays may be needed for the teachers, they may be desirable for the maintenance of home life and family ties, but they should be entirely superfluous in the matter of health. Nature has no terms or holidays—she builds up by the perpetual increment of infinite small additions. She repairs waste as she goes along. The rush of a modern school and the loafing of the long holidays have not the sanction of any natural law. It is assumed that you may "take it out" of a child to any extent provided there are long holidays. The holidays are definitely supposed to be periods of rest and recovery and children are supposed to return to school improved in health. This is all topsy-turvey. Children should be better at the end of the term than they were at the beginning and short of accidents like an epidemic this should be the test every teacher ought to apply to his management. In some schools this result is very definitely, easily and permanently attained.

A school ought to be a healthier place than a home. Because the teacher ought to be an expert in the administration of the laws of health, but parents are necessarily only amateurs and for the most part possessed of the merest smattering of hygienic knowledge. They constantly err from ignorance, from indulgence and mistaken kindness, from indolence and from over-occupation in outside affairs of life. The children of the well-to-do eat and drink unwholesome food, sit up late, go to theatres, parties, and are often wearied with sight-seeing before their teens, and if they live in towns they stick indoors and refuse to go out without an object, and are very much dependent for their health

on the annual visit to the seaside. It is not difficult for a school to do better. Among the poorer people a most marked illustration of the benefit to be derived from school may be seen in many of our infant schools. Here the children are taken from the crowded houses, from the unwholesomeness of washing day and other domestic difficulties, and put into well lighted airy rooms with cheerful companionship, singing, marching, bustling about in games directed by sympathetic and intelligent teachers. Without question the children are great gainers, and the writer has no hesitation in saying that they would do better without holidays.

The question of over-pressure is not merely one of school nor of the mind alone, nor is the schoolmaster wholly responsible for many breakdowns. The deficiencies of home life, inherited weakness of constitution, the subtle, almost imperceptible effects of infantile ailments, injudicious feeding, such as late dinners, wine, etc., cramming by conscientious governesses and music teachers, or on the other hand a slackness and want of preparation (both of body and mind) that make all application or effort a toil, assist in producing the lamentable result. No single or simple cause is efficient. A general wide survey of all conditions must be made. The first duty of a teacher is to make himself a proficient observer of the health of children and to learn how to vary his routine so that the favourable influences are continually (not intermittently) brought to bear and the unfavourable are banished. No great amount of knowledge is required. The trainers of racehorses and dogs may be trusted to bring their animals to the post in the pink of condition on the strength of close personal observation, mother wit, incessant care, and a determination to win.

THE STANDARD OF HEALTH. The first thing to do is to establish a standard of health. This is generally pitched too low. Town dwellers especially have become accustomed to

a condition of lowered vitality, and the family-doctor with an eye vitiated by the constant contemplation of sick people and convalescents is often too easily satisfied with a condition of health that is only relatively good. Personal observation should be made of really vigorous specimens of the human race, both in school and in adult life, to establish a standard of comparison, and when children fall short enquiry should be made into the causes and no pains spared to effect an improvement. Observation to a person of literary training is at first irksome but perseverance will make it easy, and the superior attractiveness of a first-hand knowledge of the real thing compared with the shadowy information derived from print, will tell in the end and make the task delightful.

One difficulty experienced by the untrained observer is in seeing things as they are and not as he would wish them to be—to divest the mind of preconceived ideas. One source of the great modern advances in medical knowledge has been the observation of the natural history of disease, in other words, noticing what happens when a disease runs its course without interference from the doctor. At one time the treatment of diseases was exceedingly vigorous, and patients were blistered, bled and cupped on the slightest pretext. But the observation of cases left without remedies has shewn how far Nature may be trusted, and afforded a standard whereby the efficacy of treatment may be estimated.

By simply looking at facts as they were a revolution was effected.

The teacher must begin by clearing his mind of prejudices in favour of his own calling. He must observe the child freed as much as possible from interference. He must note the instincts, the modes of activity, signs of fatigue, ways of taking rest. He must note the bent of the mind and the various ways in which interest is aroused and exhibited and how boredom is reached. He will then find that children naturally do certain things which conduce to health and others

which contribute to disease. He will have no difficulty in offering a guidance that will be wholly beneficial. He will learn that signs of fatigue, listlessness, mental ineptitude are his best guides, that his buildings or his method of teaching, or his subjects, or his time-table are wrong, and he will reform accordingly. He must cultivate the habit of observing children incessantly as a sailor watches the weather. But he should not attract attention. Children should not be fussed about their health, or be bothered by too many measurings, weighings, or scientific investigations. Above all they should not be questioned without cause. The outward and visible signs of health should be first noted.

THE COMPLEXION. The aspect of a healthy child should not be difficult to learn.

The cheeks are plump, the skin smooth and free from blotches or pimples, the tint more or less inclining to red, but varying from a delicate pink to a ruddy brown according to type.

English children are not naturally pallid unless born in the tropics, but those of a foreign ancestry often present a yellowish tinge which is compatible with health.

The lips are never pale.

THE SIGNIFICANCE OF PALLOR. The reddish tint of the skin and the pronounced crimson of the lips, etc. are due to the colouring of the blood shewing more or less clearly through the tissues. The colour is not held in simple solution but is due to an infinite number of small disks not unlike coins in shape. These red corpuscles (as they are called to distinguish them from another kind called the white or colourless) are very small, being only $\frac{1}{3200}$th of an inch in diameter, not more than a fourth of that in thickness. Their chief use is to convey oxygen to the tissues, and they are therefore directly concerned in the maintenance of life. Their

number is subject to great variation. A full number implies bodily vigour, but a diminution means corresponding weakness, and if reduced beyond a certain number breakdown and death follows.

The importance of the complexion as a gauge of vigour is obvious. When the number of corpuscles is so reduced that a marked pallor results the person so afflicted is said to be anæmic.

A vast proportion of town dwellers are slightly anæmic and though they pass for healthy are really carrying on life in a state of lowered vitality that only senses blunted by custom would allow us to tolerate. But though the necessities of earning a livelihood may render a change of conditions impossible to adults, no difficulties should be allowed to stand in the way of the prevention and cure in the case of growing children.

Although it arises from many causes independent of school it is to an overwhelming extent artificial—the result of an indoor life and the deprivation of sunlight. Flowers can be made anæmic by being grown in the twilight. In the early stages the pallor of the complexion may not attract attention, but the child becomes languid, loses appetite for solid food—but may even eat pastry; messes, or odd articles such as slate pencils, bits of chalk or coal—shirks games, is inattentive, yawns, and is drowsy. At this period doing away with certain lessons and substituting gentle exercise in the open air will often be all that is needed, but a pronounced anæmic should not be allowed to come to school and should be placed under medical care.

GROWTH. Growth is the *raison d'être* of childhood. If man could be born full-sized like Minerva there would be no need of childhood, but he is of necessity born small and he has to be built up to his natural stature from the outside. An infant weighs from 6 to 12 lbs. at birth (some considerably less), but a healthy adult Englishman may be

expected to weigh from 140 to 180 lbs. without any superfluous fat. It is by the absorption and assimilation of substances in the shape of food derived from the animal and vegetable kingdoms that the transformation of the tiny infant to the full-grown man is effected. If a child does not grow it is because it is not absorbing sufficient food. Either the food is insufficient in quantity or of indigestible quality or the organs are not doing their duty. "One man's meat is another man's poison" because one man has a powerful digestion and the other has not—and the problem of providing wholesome food is much simplified by providing an active penetrating gastric juice. Failure of growth means a digestion not doing its appointed work of supplying repair of present waste and putting by something for the future. Insufficient supply to any growing organ means a failure of that organ to reach its natural capacity in adult life. It may be the heart, or brain, or the limbs that suffer from the deprivation, but if the full vigour and strength is not reached during growth the deficiency can never be made up. We can train an organ comparatively late in life, but we cannot build up its force.

Taking the growth as an indication that the nourishment of the body is or is not proceeding properly, the teacher should devise means for keeping some record of measurement. But little time need be occupied and the teachers' work need not be much increased. Children are always interested in their own heights, and prefects may be trusted to be sufficiently accurate for school purposes. A rough measurement is always desirable for the allocation of writing-desks, for classification in runs and contests and is sufficient for practical purposes. In taking measurements the teacher must rely on his own observation of the children under his care and beware of being beguiled by tabulated averages which from the nature of things fit nobody accurately. It cannot be too clearly laid down, or too frequently repeated, that the business of the schoolmaster is with the individual

and not with the mass, so that the minute measurements that might be serviceable to anthropometry are not immediately useful to the particular pupil whose well-being happens to be in question. The problem is not whether the average growth of the boys in Mr. Blank's school is above or below the published average, but whether the growth of Exe minor or Wye major is proceeding at their own normal rate as ascertained by previous measurements. The growth of children is of course liable to be affected by various causes independent of the temporary conditions of health. Short people grow less than tall and allowances must be made not only for national but for district differences of stature. A rate that would be satisfactory in a boy from a Welsh family would be unsatisfactory in one from a Yorkshire, or one from Surrey compared with one from Connaught. Generally speaking the opulent classes grow quicker than the labouring and manufacturing.

But the general characteristic of healthy growth is its conformity to a settled plan, the variations occurring at settled periods as trains may be run at different rates of speed over the same ground but always slowing at the same hill and quickening on the same down gradient. The rate at which each train mounts the gradient is in a definite ratio to its hourly mileage, a good pace for the thirty miles train might mean failure of steam for the express, but a retardation on the level would surely indicate something wrong with the engineering of both.

The published statistical tables are very confusing to readers who do not combine some medical with arithmetical knowledge.

Typically healthy growth during school-life should be uniform with two exceptional periods, one between 11—13 of slight retardation, the other of great acceleration between 15—17 in boys About a year younger for girls.

Boys who may be expected to attain a height of 5 ft. 6 in.

—5 ft. 8 in. grow about 2 inches per annum; the nearer they keep to this standard the more stalwart they are likely to be. Much less than this if regular indicates a dwarfed stature, if irregular defective nutrition or illness. If above 3 inches per annum besides indicating a corresponding tall stature involves a great strain on the stamina.

In the curious period of retardation not more than half the usual annual rate is likely to be reached.

In the great start of puberty the ordinary rate may be doubled. In both sexes, but more especially in girls, this period is one of great stress and of inestimable importance in the development of the constitution. Muscular and brain-work should be lessened, no feat requiring long-sustained exertion either of body or mind should be allowed. A jealous watch should be kept for the earliest symptoms of failure and immediate and decided measures taken to give relief. It is at this dangerous period that the "seeds of consumption are sown," or that an adequate nervous system has its development arrested so that it grows up with a fraction of its intended power and exhibits weakness in the shape of hysteria, neuralgia, irritable temper, and even insanity.

Teachers of singing are the only people who have preached a physiological rest—they are wiser than others, as the voice is something whose quality can be measured by the senses, whereas the nervous system is only understood by physicians after long study. But what is true of one organ is true of the whole body and every part of it. Heavy strains must be paid for dearly in after life.

CHEST-GIRTH. Increase in the circumference should also be steady, but no very precise rule can be given. Half an inch per annum may be taken for a fair average for two inches of growth. Rather less at the period of retardation, and about 1½ inches during the remaining three or four years. The development of the chest does not follow the

startling increase in the limbs that occurs in the one critical year, but failure to maintain its own rate of growth throughout should be viewed with suspicion. The development of the chest is much more an affair of management than the length of the legs, which is to a great extent settled by nature. Indoor sedentary life means shallow breathing and a poor chest. But no part of the body responds so rapidly and surely to systematic exercise. Mr Maclaren's reports of the Oxford Gymnasium are well known and most instructive, but equally convincing results can be obtained with children taken haphazard, reducing the amount of the conventional desk-work and substituting equable, graduated, and simple gymnastics suited to the age. A broad chest is one of the best guarantees for success in life, but an ill-developed, narrow, pigeon-breast is a handicap on hard work and often little better than a death-trap.

WEIGHT. The most dependable test of a child's increase in bulk is the weight. An adult should maintain a fairly even standard, putting on or dropping a few pounds according to circumstances without any marked variation in health; but a child should steadily increase year by year according to a definite standard. Failure to reach that standard must be regarded as an ill omen and actual *loss* of weight a sign of imminent danger.

Many tables have been published but they have only a limited value in practical work as they deal in averages and are therefore inapplicable to the individual. It cannot be too often repeated that the business of the teacher is with the individual and not with the mass. The question is not whether a child's rate of growth is above or below the average—as the phrase runs—but whether he is or is not maintaining his own proper standard and whether that standard is one that has been unfavourably influenced by outward circumstances.

The teacher who desires to keep himself informed of the

progress of his pupils should therefore ascertain the rate of increase peculiar to each child and take that and not the table of averages for his guidance.

The weight ought to bear a constant relation to the height, the margin of variation being small.

At 5 years of age a child weighs about the same number of pounds as he is inches high—a healthy child may be expected to be about 40 inches high and if sturdy a few pounds more in weight, say 42 to 44. The sexes are on an equality.

The rate of increase should be about 2 lbs. to 1 inch of growth and there should be a tendency for the proportion of the weight rather to increase. Excess of weight over height is a favourable sign—a deficiency unfavourable. In lanky, weedy children the weight is frequently outstripped—in common phrase "they outgrow their strength." These children should be made to rest by lying down in the daytime, be carefully fed on plain nourishing food; exercised in the open air sufficiently to maintain a healthy appetite, but not so much as to cause fatigue. All mental application that is not interesting and amusing should be rigorously stopped. With adequate care a temporary disturbance of the proportion of height to weight need not lead to permanent harm, but without precautions, often of the most stringent kind, these weeds are liable to grow literally *up* and never to attain their proportionate health and strength, so that they are burdened with a skeleton too long for their muscles and nerves and are easy prey to all those diseases which invade the feeble.

The rate of increase for the two sexes is fairly uniform till the onset of puberty, when in both a sudden start occurs corresponding with the acceleration of growth. The change is more remarkable in girls than in boys, but it lasts a shorter time. The transformation of the girl into the woman is a more abrupt, more rapid and more exhausting process than the change of boy to man.

The exact date of course varies but when it occurs is so

remarkable that it cannot escape observation. It is now that the due proportion between increase in height and weight is likely to be adversely affected. It is now that the calls made by nature on the system are often dangerously exhausting and leave no margin for mental or bodily exertion. Fatigue must be avoided as a danger. Cases in girls observed as over-pressure have resolved themselves into nothing more than efforts to continue a not excessive amount of study during this period of constitutional strain. If a girl seems to flag without obvious cause she should be weighed, and if the weight is deficient everything thrown aside till the balance is restored. The routine of schools is purely artificial and bears no rational relation to the laws of the body's development, and unfortunately preparation for examinations is so mistimed that occasionally an increase of work and responsibility occurs at the time when both should be lessened. Growth at this juncture is not merely increase in bulk, but the transformation of a being hitherto merely self-existent into one capable of giving life to others. The wise teacher will regard nature's work with reverence and recognize the propriety of sparing the nervous system until the time of stress has passed.

The following table of proportionate height and weight during school-life (Ashby and Wright), will be found useful.

Height inches	Weight lbs.	Height inches	Weight lbs.
40	44	51	67½
41	46	52	70
42	48	53	72½
43	50	54	75
44	52	55	77½
45	54	56	80
46	56	57	82½
47	58	58	85
48	60	59	87½
49	62½	60	90
50	65		

Measuring and weighing do not replace but give precision to personal observation. The teacher should cultivate the habit of watching the physical development of children at first hand. He should especially frequent the swimming-bath and make himself acquainted with the plump rotund appearance and firm feel of strong growing muscles compared with the unsatisfying outline and flabbiness of the ill-nourished, whether from insufficiency of food (as amongst the poor) or insufficiency of exercise as amongst the sedentary. The familiar act of "feeling the biceps" affords more information than the tape. The shape and mobility of the chest should be observed. Contrast the well-curved sides and the free lift on inspiration of the well-grown out-door child with the poor flat front and the sunken hollow under the collar-bones, the feeble respiratory movement of the sedentary town-dweller and remark the flattened sides and narrow frontage of the pigeon-breasted. The final outcome of these chests should be studied in the adult. Nothing is more convincing of the value of physical culture in youth than a comparison of the efficiency in life of men with broad chests with their feebler brethren. Note should also be taken of the growth of the bones—if the limbs are equal in length, if the child stands straight with a vertical spine, or whether one shoulder is higher than the other with a lateral crook in the back, of bow-legs, knock-knees, inturning of the ankles, flat-foot, overlapping of the toes. After a careful study of the nude, awkward movements will be easily detected in the clothed and referred to their right cause, and the teacher thereby enabled to recognize the beginnings of perverted developments in the play-ground.—No knowledge is better worth cultivating, as failure of growth may very frequently be remedied if taken in time but if neglected a defect that need only be temporary will become permanent. Besides the visible aspects of growth, we must remember the internal organs are at the same time developing well or ill in accordance with the general rate of progress made by the whole body.

THE NERVOUS SYSTEM. The nervous system is the seat of all bodily and mental force. From it are derived the power that causes the heart to beat and the influence that regulates the rapidity of its pulsations. The foot in walking or the hand in writing are as much moved by the brain as are the limbs of marionettes by the fingers of the hidden showman. Breathing, digestion and other inner functions all depend on the nervous system though all are not equally under the control of the will. In brief the whole machine may be said to be driven by the brain as the prime mover, but the brain being in itself a bodily structure is dependent for its nourishment and vitality on the very organs it governs. Thus a shock to the nervous system will give rise to indigestion, this leads to insufficient nourishment of the brain, which becomes further weakened from lack of food and more and more incapable of providing the necessary nerve-force to the stomach for the performance of its work, and so the reciprocal enfeeblement goes on, cause and effect changing places and culminating in a permanent injury to the efficiency of both organs.

Intellectual work, though apparently metaphysical, is also an outcome of brain activity. The movements of the muscles required in the arts of music, sculpture and painting, articulate speech, writing, all result from action of portions of the brain acting in combination, and the same is true of perception by the senses, of memory, imagination and abstract thought. The painter drawing the outline from a model, the mathematician making a calculation, the philosopher evolving a theory, all set a portion of the brain in action, all cause the destruction of a portion of the brain tissue which is thrown off as waste products. These must be removed and the waste repaired by fresh brain just as certainly as the ashes must be taken from a furnace and replaced by fuel if the engine is to go on.

During school-life the nervous system is called upon to provide for (1) the general muscular movements of bodily exercise. This removes more waste-products than it causes

and promotes repair by improving appetite and digestion; (2) for the small muscular movements of writing, drawing, &c. and the purely intellectual work of learning. These cause waste-products, but do not assist in their removal and therefore tend to final enfeeblement; (3) for the exhausting strain of growth and consequent changes. These in nowise provide for repair, and sometimes occur with such violence that they may be likened to a run on the bank and only be met by calling on the reserve and strict economy in all other outgoings.

The peculiarity of the nervous system is that it is built up very slowly, but it is liable to very sudden destructive changes. A blow on the head may convert a potential genius into an idiot. "The brain, it should never be forgotten," says Sir J. Crichton Browne, "is made up of explosive material, the explosiveness of which may be heightened or reduced. In states of disease such as insanity or epilepsy the brain-substance, or certain tracts of it, are raised to a higher degree of explosiveness, as gunpowder is when mixed with nitro-glycerine. In states of idiocy or imbecility it is reduced to a lower degree of explosiveness, as gunpowder is when mixed with moistened clay so that it only burns slowly away or will not light at all." This illustration by one of our highest authorities conveys no more than the exact truth which should be pondered by every teacher. Sir J. Crichton Browne of course speaks from the actual evidence that has come under his notice, evidence as tangible to him, a skilled observer, as the debris of a building after a firework explosion would be to a surveyor. But he might have added that though the results of the explosion are manifest afterwards there is neither noise nor smoke at the time of its occurrence—nor is there always sufficient warning to enable us to avoid the catastrophe. It may be compared to short-circuiting, which occurs without warning and lasts scarcely a second, and yet may throw an expensive galvanic battery entirely out of gear and perhaps destroy it.

Thus the teacher will perceive he is in charge of a machine of which he does not and cannot understand the construction —one not fully formed, but liable automatically to inflict injury on itself, and one which he may as readily influence for evil as for good.

WARNINGS OF THE EXPLOSIONS. Precocity is the delight of parents and ill-informed teachers. Two kinds may be distinguished. (1) Natural, in the case of genius, as in Goethe, Mozart, Pascal, and Christopher Wren. It indicates a brain of unusual character and often corresponds to an exceptional physique, capacity for endurance and longevity. (2) Merely exceptionally rapid growth (activity as contradistinguished from stability), great impressionability, receptivity and excitability. These children see their way to good places in class and can accomplish their wishes, they are often highly emotional and sensitive to praise or blame, easily egged on by emulation. They can be run with a minimum of trouble for examinations and scholarships. The brilliancy they exhibit is not strength but excitability.

It is a matter of common observation that the after-careers of show children do not correspond with their start, but the suspicions of the literary teacher are scarcely yet aroused to the danger and inefficacy of pushing them.

But however contrary it may be to justifiable aspirations and wishes the conscientious teacher should regard a precocious mental activity unaccompanied by exceptional physical strength (broad chest, big limbs, equable growth and calm disposition) with grave suspicion and generally an indication for putting on the drag and not for the use of the whip. Common sense would dictate that if a child present more than ordinary cleverness, either from genuine natural gifts of a stable order or from exceptional impressionability, there is the less need for pressure, and if the artificial baits of grants, scholarships and the examination-advertisement could be withdrawn from our

system no doubt common sense would prevail and a reasonable course be pursued. But temptation is placed in the way of teachers to do wrong under the similitude of duty.

Visible warnings. Epilepsy in its more pronounced form is a familiar disease, but it also occurs in a masked form without the ordinary convulsions, and accounts for strange short lapses of memory, unwarrantable and unaccountable exhibitions of passion and periodical fits of dulness. A bad form occurs only at night during sleep and can only be inferred from the wetting of the bed and lethargy on the following day or days.

St Vitus' dance is well known to follow on fright and emotion in certain constitutional states.

Physicians consider these diseases, though not directly caused by school, as liable to considerable aggravation by bad educational methods. In a minor degree jerkings, twitching and even fidgets may be signs that the nerves are becoming unstable and require bracing up.

School-headaches. The teacher should be on the alert to discover headaches in the oncoming stage when they are rather a symptom than a disease and therefore curable. If not checked they may persist, like all disorders of the nervous system, long after the original cause has ceased to exist. Healthy children never suffer from them and they therefore betoken either something wrong with the constitution or some defect in hygiene. When existent no trouble should be spared to discover the cause and apply the remedy. In enquiring about headaches and other pains direct questioning should be avoided, partly because children should not be encouraged to consider their own health too curiously, and partly because the way of the malingerer should not be made easy.

The headaches commonly found in schools are the following:

(1) Those due to temporary causes, such as injudicious feasting at the tuck-shop, late parties with suppers of sweet things and wine (!), smoking, the early stages of cold in the head, the premonitory stages of epidemic diseases.

(2) Those occurring in weakly children unfitted to withstand the strain of school-life. There are generally other signs of debility, anæmia, poor appetite, languor, fidgets, nervousness. But often no obvious sign of ill-health is present and the children appear robust so long as they are favourably placed. But the confinement and headwork of a school falling upon a nervous system which is immature begin to tell upon them. After a period in which headaches occurring after difficult tasks, a little over-excitement, &c., give warning of danger, some definite symptoms make their appearance and a breakdown occurs. Children of this kind withdrawn from school and sent to a farm where the greater part of the day can be passed in the open air are often revolutionised. With regard to the question whether positive disease can be provoked by trying to push through with a brain unfitted for its work, the answer seems affirmative. Sir J. Crichton Browne entertains no doubt on the point. Bearing in mind the extreme liability of the child's brain to become the seat of inflammation on small provocation the necessity for extreme caution in regard to headachy children is apparent.

(3) Those occurring in children with obstructed nostrils and frequent cold in the head. The dulness and heaviness of a cold in the head are well known and are due to the swelling of the mucous membrane. Neglected children are sometimes seen, some disgusting discharge always falling from their nostrils, their breathing obstructed by adenoids and tonsils. They are exceedingly liable to headaches which disappear after proper treatment of the nose and throat.

(4) Those dependent on eye-strain. The overwhelming majority of school headaches are due to this as a first cause. The greater proportion are relieved by the mere use of proper

spectacles, and give little or no trouble, but there is a small residuum in which the nervous system has become artificially over-sensitive and the habit of pain remains after the most careful adjustment of glasses. The kindest and the shortest plan with these cases is to send them into the country for a term or two. As a rule headaches depending on the eye are quickly as well as effectively cured by spectacles alone.

CHAPTER XIV.

OVER-PRESSURE AS AFFECTING THE INTELLECT.

WHEN we approach the hygiene of those elements of the nervous system which take part in what are termed mental processes the difficulties of observation increase. The origins of good and ill are less tangible. There are no means of weighing or measuring—there are no standards for comparison; whether strength is being gained or lost, whether growth is equable or disturbed, can only be estimated by personal observation and inference. The welfare of the larger muscles and that part of the brain which governs them can be directly tested by noting if the increase of strength is in satisfactory accordance with age and growth, by the record of weight lifted, or the work on the parallel-bars, the pace in the running-field or in swimming, and so forth. All these facts can be measured by scale or tape or stop-watch with the greatest accuracy and entered in a ledger. But the perfection of "mental processes" cannot be gauged. The working of the higher intellect is an inscrutable mystery and cannot be measured except in a rough and very inaccurate manner. It might be supposed that a child's capacity to learn lessons would afford a safe guide to the condition of its brain. But no: as well attempt to measure the healthiness of its digestion by its capacity to swallow food. It is well known that children will eat too much, or choose unwholesome food, and starve in

the midst of plenty from the discrepancy between their appetite and assimilation.

Certain disorders of the stomach are accompanied by "feelings of sinking" and an increased desire for food so great as to look like greediness, and the food swallowed only aggravates the evil. In the same manner excitement or irritation of the brain may give rise to a temporary increase in the capacity to learn, and a spurious cleverness which it is impossible to distinguish from the genuine and healthy action of the intellectual centres.

Actual destructive diseases of the brain, both in child and adult life, are often preceded by a period of exceptional activity and brilliancy to be followed by a lamentable fall. Hence the necessity for caution in dealing with show children.

Part of the business of the educator is to stimulate and exercise (with the requisite gentleness be it understood) the centres of the brain in proportion as their activity becomes manifest. In order to do this no recondite knowledge is required. A profound conviction of the delicacy and complexity of the organs in question and close observation of the doings and sayings of individual children must form the basis of safe teaching. The teacher does not make or call into existence any part or function of the brain as ambitious mothers are prone to believe. He plays the part of the driver, who has not bred his horses but who by the right use of reins and whip regulates the paces and economizes the energies of his cattle, so that not only does a good whip get more out of his team than a bungler, but they are in better condition and they live longer.

There is all the difference between good and bad teaching that there is between good and bad driving. In studying children from infancy (and no teacher should omit infancy) especial note should be taken of what they do spontaneously, what use they make of opportunities, and what they do by dint of imitation. A conscientious observation of these indications

used in devising the scheme of education best adapted to individual children would be the death-blow to more than half the artificial teaching at present in vogue.

For instance, children present certain common characteristics, the difference being in the rate of development and not in the order. A baby in the early stages puts anything it takes hold of into its mouth, later on it will look at the object before tasting, later still the tasting is omitted. There is never any variation in the order in which these processes occur, so of others. Nature observed without prepossession, will be found to be occupied with the development of the senses and the regulation of muscular movement long before any purely intellectual qualities are shewn, and this order is not dependent on teaching but on the growth of certain sections of the brain. Now during this nascent period the senses can be most easily trained in combination with muscular movement, but only with difficulty in combination with the reasoning powers.

A most obvious combination of a sense with muscular movements is speech. A word is heard by the ear and imitated by the movements of the mouth—a great number of sounds heard and imitated constitutes a vocabulary.

Children of normal intelligence acquire extensive vocabularies with amazing facility if entirely taught by the ear, but they learn very slowly and retain very badly if taught by means of books. This is the stage at which languages can be profitably taught (orally), singing, music and dancing—for the sense of hearing is in its most receptive condition and the muscles most obedient to instruction. To listen to music and to dance is natural to healthy children, and though the discipline necessary for learning the steps may at times be irksome the dancing lesson itself (if not foolishly prolonged) is pleasant because it is (in part at least) a fulfilment of a natural instinct. In like manner children can be taught to draw not only triangles, polygons, and geometrical forms but complicated patterns and the shapes of natural objects and animals—in

other words, to draw anything they see—long before they can be taught by their own reasoning or the reasoning of others that the angles at the base of an isosceles triangle are equal. But public opinion demands that the angles should be understood, and the delusion exists that the *sooner* they are begun the *better* they will be mastered. So far from this being the case years are frittered away in confusion and irritation without any good result because the necessary sections of the brain are not yet sufficiently matured to assume effective action.

It is beyond the province of this essay to do more than hint at the natural bases of education, but the foregoing essential point requires to be grasped in order to understand why the ordinary studies are so ineffective with some children, so irritating to others, and so benumbing and stupifying to an unfortunate few.

A comprehension that the brain is a complicated sectional organ occupied like the rest of the body with the exhausting process of its own growth—*in its own manner and its own time*—lies at the bottom of the hygiene of the nervous system. The common-sense rule is to follow the dictates of nature and watch the development of every faculty before attempting its cultivation. Unfortunately every function is capable of stimulation *before* its time. The danger of certain vices is universally admitted to depend on this fact. It is undoubtedly true of the mind. Clever, excitable children can be stirred up to a fictitious display of mental ability that is deceptive even to cautious and experienced observers. Only the miserable failure in after-life betrays the mischief done. But in certain cases the ill effects are visible at the time.

Beginning with very slight indications, fidgets, twitchings, excessive sensibility to moderate reproof, unreasonable outbursts of temper, irregular brain-action, fits of sharpness being succeeded by fits of stupidity, or quickness in learning by inexplicable slowness over similar tasks, "over-pressure" may shew itself by well-marked signs.

Excessive difficulty in getting to sleep and talking in the sleep—disturbed dreams, somnambulism and night terrors are due, of course, to many causes of irritation (*e.g.* indigestion or worms) besides mental irritation, but are frequently due to over-excitement of the brain from lessons.

A mother volunteered the statement (without understanding its import) that her boy "walked in his sleep" always on the night of his most difficult lesson.

Hysteria is generally associated with the idea of attacks of uncontrollable laughter, tears, kicking, &c. and rather a subject for joking, but the real affection is a most lamentable defect in nervous nutrition, and shews itself in many strange fashions, especially by a mimicry of genuine diseases. The victim presents all the appearances of being a malingerer without really malingering. Excruciating pains are felt in the joints, loss of power in the legs, partial blindness in one or both eyes, &c. The moral nature appears to suffer, and incredible deceptions are practised by girls who have formerly been open and truthful. Boys are not exempt, but the symptoms are generally less marked. No doubt exists in the mind of well-informed physicians that though the affection is spoken of contemptuously and its symptoms are frequently ludicrous, it is a definite and serious malady, capable of wrecking the happiness of lives. The influence of school may cut both ways—so far as irritation from injudicious or excessive literary tasks goes it may tell badly, but so far as order, method, and discipline are concerned it may work for good.

From the foregoing it will be perceived that the special danger to the nervous system from schooling is exhaustion by premature stimulation, and that the chief error to be avoided is that of supposing that all brains are equally developed, or even adapted for a system of education which is purely artificial and conventional. Thereby occurs a waste of energy which in some cases may cause friction and worry, and suffice to injure a nervous system, with the balance dipping

towards the wrong side from causes unconnected with school. The mistake generally made is to endeavour to make the child fit in to the school routine rather than to modify the routine to meet the peculiar needs or weakness of the child.

Children vary astonishingly in nervous energy—even more remarkably than they do in physique—and the same child varies from time to time according to the calls made upon its constitution. Thus the period of the second dentition affects some children, especially those brought up without sufficient open-air exercise. A child is naturally less impressionable than it is in infancy, when "cutting the teeth" may amount to a source of danger, but anyone who has suffered from the worry of a tender tooth or an aching jaw may realize that the process of replacing one set of teeth by another may be a serious drain on the nervous energy of a poorly constituted child. The accomplishment of puberty is sometimes accompanied by very curious mental disturbances, untowardness, morbid introspectiveness, religiosity, and other signs of debility to those who know how to read them. Unfortunately at this time of stress important examinations often have to be faced, and a temporary condition is aggravated and prolonged by the necessary hard work and inevitable anxiety. All who have had charge of the young are aware of the difficulty of managing this troublesome period.

The fag-end of winter—miscalled the spring—finds some children in an exhausted condition, requiring considerable relaxation of work and increase of rest. Convalescence from febrile diseases—measles, scarlatina, mumps, typhoid, &c. is another period to which sufficient importance is not attached. The fact that a great acceleration of growth frequently takes place during the attack indicates that vital processes have been hastened and a compensatory slack time is required. The ill effects of immoderate reading in the early period of recovery must not be forgotten. A comparison of the ratio of weight to growth assists in forming an opinion.

Even the time of day has to be considered. A child that is fresh and capable in the morning may be enfeebled by the afternoon and incapable of any safe work in the evening. The custom of postponing preparation till the evening is opposed to physiology and common sense. Its prevalence is evidence of the neglect of hygiene by educators. There is some reason for supposing that it is rather of modern growth, and due possibly to great improvements in artificial lighting that followed the invention of gas. Leigh Hunt in his account of Christ's Hospital school (*circa* 1800) gives the hours of leaving off work at 4 p.m. in winter and 5 p.m. in summer. If this is true of other schools we may in this matter with advantage recur to the wisdom of our ancestors.

L'ENVOI.

Over-pressure is not a positive condition, but a failure to reach the potentiality of the bodily and mental strength in any given child, and due not to one cause but to the action of a number of small influences acting in combination in a direction that makes for ill, and a concurrent omission of those influences which should in the course of nature be allowed to make for perfect development. The wise teacher will bear in mind that he may aggravate or counteract the evil influences of ancestry, unhygienic home surroundings, or a bad dietary. He will mistrust the artificial routine of educational systems and apportion his tasks to the development of his pupil. He will study the causes that tend to the promotion and growth of the young animal—viewed frankly as a young animal; and he will not be drawn from his course by the temptation of successes at examinations or the cheap applause of ignorant and exigeant parents. He will find he needs little beyond a steady first-

hand observation of children for the means of acquiring the necessary facts, and little beyond common sense and a moderate degree of invention in devising methods for the attainment of his object. But he must above all things begin with an open mind and resolutely put aside all pedagogic prejudices, and remember that Nature never omits to call for the payment of a debt, only unfortunately she is not always certain to call upon the true borrower. The sins of the fathers are visited on the children, and so also unfortunately are those of the schoolmaster.

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